A conceptual framework for environmental service payments in South African plantation forests

by

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Declaration

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Abstract

Plantation forests contribute to supplying environmental services and goods such as carbon sequestration, clean water production and hydrological cycle regulation. Environmental services are the benefits people obtain, enjoy, consume and use from the environment free of charge and play a significant part in the earth's climate directive to filter wastes and pollutants.

While plantation forests are well recognised for their contribution to meeting the ever-increasing demand for wood and fibre products, their role in supplying environmental services is less defined. There are societal benefits from environmental services generated by plantations, but also concerns about the increasing development of large-scale plantations. Such concerns include loss of soil productivity, disruption of local water cycles, risk of pests and diseases, and influences on biodiversity. Payment for environmental services could potentially assist in balancing the environmental costs of and benefits from plantations. This is an attractive conservation tool that is used to preserve and restore environmental services, and in terms of which the user of environmental services pays the provider to supply the services.

Many forestry owners around the world are conserving and restoring important environmental services through payment for such services. A conceptual framework of environmental services provided by commercial plantations and forests, combined with a suitable payment for the environmental service system, is lacking in South Africa. Therefore, this study aimed to define the concepts and review different types of payment for environmental service schemes. The study was conducted to investigate the positive and negative influences on environmental services associated with commercial forestry plantations, to identify possible buyers and sellers of environmental services in commercial plantations, to investigate the influence of compensations and penalties on environmental services in commercial forestry plantations, and to develop and test a conceptual framework of payment for environmental services in South Africa.

A detailed literature study was done to identify and investigate different types of payment for environmental service methods used globally. A key informant e-mail survey was conducted with 25 participants amongst forestry and environmental experts, including managers of forestry companies, foresters, environmental managers and academics. This was followed by a Delphi study among a small number of experts. The data collected was used to develop a conceptual framework for payment for environmental services in South African commercial forestry plantations. The outcomes of the study can be used to assist forestry companies in South Africa to protect and conserve environmental services through a-developed payment for environmental service scheme.

Key words: Plantation forests, environmental services, payment for environmental services, key informant survey, Delphi study survey, conceptual framework.

Opsomming

Plantasiebosse dra by tot die verskaffing van omgewingsdienste en goedere soos koolstofbinding, skoon waterproduksie en hidrologiese siklusregulering. Omgewingsdienste is die voordele wat mense gratis uit die omgewing verkry, geniet, verbruik en gebruik en speel 'n belangrike rol in die aarde se klimaat doel om afval en besoedeling te filter.

Terwyl plantasiebosse baie goed erken word vir hul bydrae om in die steeds toenemende vraag na hout- en veselprodukte te voorsien, word hul rol in die lewering van omgewingsdienste minder omskryf. Daar is maatskaplike voordele van omgewingsdienste wat deur plantasies gegenereer word, maar ook kommer oor die toenemende ontwikkeling van grootskaalse plantasies. Sulke bekommernisse sluit in die verlies aan grondproduktiwiteit, ontwrigting van plaaslike watersiklusse, die risiko van plae en siektes, en invloede op biodiversiteit. Betaling vir omgewingsdienste kan moontlik help om die omgewingskostes en voordele van plantasies te balanseer. Dit is 'n aantreklike bewaringsinstrument wat gebruik word om omgewingsdienste te bewaar, te herstel, en waarvolgens die gebruiker van omgewingsdienste die verskaffer betaal om die dienste te lewer.

Baie bosbou-eienaars regoor die wêreld bewaar en onderhou belangrike omgewingsdienste deur die betaling vir sulke dienste. 'n Konseptuele raamwerk van omgewingsdienste wat deur kommersiële plantasies en woude gelewer word, gekombineer met 'n geskikte betaling vir die omgewingsdiensstelsel, ontbreek in Suid-Afrika. Daarom het hierdie studie ten doel gehad om die konsepte te definieer en verskillende metodes van betaling vir omgewingsdiensskemas te hersien. Die studie is uitgevoer om die positiewe en negatiewe invloede op omgewingsdienste verbonde aan kommersiële bosbouplantasies te ondersoek, om moontlike kopers en verkopers van omgewingsdienste in kommersiële plantasies te identifiseer, om die invloed van vergoedings en boetes op omgewingsdienste in kommersiële bosbouplantasies te ondersoek, en om 'n konseptuele betalingsraamwerk vir omgewingsdienste in Suid-Afrika te ontwikkel en te toets.

'n Gedetailleerde literatuurstudie is gedoen om verskillende soorte betaling vir omgewingsdiensmetodes wat wêreldwyd gebruik word, te identifiseer en te ondersoek. 'n E-posopname onder sleutel informante is uitgevoer met 25 deelnemers onder bosbou- en omgewingskenners, insluitend bestuurders van bosboumaatskappye, bosbouers, omgewingsbestuurders en akademici. Dit is gevolg deur 'n Delphi-studie onder 'n klein aantal kundiges. Die data wat versamel is, is gebruik om 'n konseptuele raamwerk vir betaling vir omgewingsdienste in Suid-Afrikaanse kommersiële bosbouplantasies te ontwikkel. Die uitkomste van die studie kan gebruik word om bosbouondernemings in Suid-Afrika te help om omgewingsdienste te beskerm en te bewaar deur middel van 'n betaalskema te ontwikkel vir die omgewingsdiensskema.

Sleutelwoorde: Plantasiebosse, omgewingsdienste, betaling vir omgewingsdienste, sleutel informante-opname, Delphi-studieopname, konseptuele raamwerk..

Dedications

This thesis is dedicated to my late grandmother, Gladys Madula, and my late auntie, Rudzani Precious Madula. Losing you in the same year was so painful, but with time I learnt to live with it. If you were around, you would be immensely proud of what I have achieved in life and I am sure you will be celebrating this achievement with me. I will forever be grateful for your love. Continue to rest in peace.

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List of abbreviations and acronyms

CF	Conceptual framework
CO_2	Carbon dioxide
ES	Environmental services
FAO	Food and Agriculture Organization
FIEC	Forestry Industry Environmental Committee
FMU	Forest management unit
FSA	Forestry South Africa
FSC	Forest Stewardship Council International
GHG	Greenhouse gases
IA	Independence Agency
IAP	Invasive alien plants
MEA	Millennium Ecosystem Assessment
NDCs	Nationally determined contributions
NEMA	National Environmental Management Act
NGO	Non-governmental organisation
PEFC	Programme for Endorsement of Forest Certification
PES	Payment for environmental services
PSAH	Payments for Hydrological Environmental Services Programme
REDD+	Reducing Emissions from Deforestation and Forest Degradation
SA	South Africa
SAFAS	South African Forestry Assurance Scheme
SANBI	South African National Biodiversity Institute
SDGS	Sustainable Development Goals
UNFCC	United Nations Framework Convention on Climate Change
WfW	Working for Water
WOF	Working on Fire

Chapter 1: Project background

1.1 Introduction

Plantation forests of exotic pine, eucalypt and acacia trees contribute to about 1.27 million ha of forest resources, or 1.1% of the country's land area, in South Africa (SA) (South African Government, 2020). Most commercial plantations are located in the Mpumalanga, KwaZulu-Natal, Eastern Cape and Western Cape provinces, where climate and soil conditions are suitable. These plantations offer the raw material for pulp milling, saw milling, and wood chip and paper manufacturing (South African Government, 2017).

Plantation forests also contribute in supplying environmental services (ES), such as biodiversity conservation, landscape beauty, recreation, water regulation and carbon storage, for climate change alleviation. ES are defined as the productions of ecological systems that generate quality of life (Mander, 2012). These are benefits that humans obtain, enjoy, consume and use from the environment free of charge and play a significant part in the earth's climate directive to filter wastes and pollutants (Pagiola *et al*., 2004).

Commercial plantations supply and support environmental services by planting trees to reduce soil erosion and control water run-off (Rosoman, 1994). The level of ES supply and support varies, however, during the rotation of production cycles of tree planting, growing to maturity and harvesting (Forestry SA [FSA], 2021). Plantations can also have negative biodiversity effects when natural vegetation is cleared for plantation establishment. These negative effects can potentially be balanced with an innovative instrument, known as payment for environmental services (PES) (Shackleton *et al*., 2007; Sherbut, 2011). PES is an attractive conservation tool used to preserve and restore environmental services, whereby the user of the ES pays the provider to supply the service (Wunder, 2008).

A system to manage environmental services provided by commercial plantations and forests, combined with a suitable PES system, is lacking in South Africa. This study aimed to define and present the various concepts associated with a PES scheme in a conceptual framework. Both positive and negative environmental effects on environmental services provided by plantation forests in SA were investigated, with the aim to assist forestry companies in SA to protect and conserve environmental services through well-developed PES schemes.

1.2 Rationale for the study

A well-managed commercial plantation can help in preserving environmental services. This can be done through good land-use management that provides a well-organised source of renewable raw materials to mitigate climate change (NGP, 2015). For instance, plantation trees can remove CO_2 from the atmosphere and store it in their timber and end-use products (FSA, 2020). It must however be recognised that plantations are planted and harvested in rotation cycles where sustainable harvesting of these plantations can only result in combating climate change if the rates of harvesting and planting are co-ordinated in such a way that the amount of CO_2 taken by the timber plantations remains the same (FSA, 2020).

Plantation forests play a role in protecting and conserving ES; however, they can equally cause negative environmental effects such as soil disturbance during the first stage of preparing land and establishing plantations (Kubiszewski *et al*., 2017). Other negative effects occur during felling and immediately afterwards, when the land lies without vegetation. Plantations can also play a role in decreasing overall water yield and streamflow, which affects aquatic life and downstream users

(Rosoman, 1994). Therefore, there is a need to balance the positive and negative aspects of commercial forestry plantations. This can potentially be done through PES, which is used as an approach to manages environmental services through cash payments or other forms of compensation or rewards to motivate environmental conservation and restoration (Milder *et al*., 2010).

Payment for environmental services was also designed and introduced to save forests from being exploited and for landowners to use ES wisely (Laurans *et al*., 2012; Miranda *et al.*, 2003). The concept of PES is a specific voluntary action that uses economic incentives to protect the environment (Budhi *et al*., 2016). Many forestry owners around the world are acting on conserving and restoring important environmental services through PES (NGP, 2015). Current literature indicates that PES is also being used to manage the use of ES in SA by promoting sustainable land use and improved management of scarce water resources (Sherbut, 2011). It therefore is important to determine how PES schemes are being implemented in the forestry plantation sector in SA. This study involved identifying and analysing PES schemes that could potentially be used by the commercial plantation forest stakeholders in SA.

1.3 The study objectives

The main objective of the study was to develop a conceptual framework (CF) for determining a suitable PES scheme that can improve ES provided by commercial forestry plantations in SA.

Specific sub-objectives were to:

- Investigate the positive and negative effects on environmental services associated with commercial forestry plantations;
- Identify possible buyers (beneficiaries) and sellers (providers) of environmental services in commercial forestry plantations;
- Investigate the effect of compensations and penalties on environmental services in the commercial forestry plantations; and
- Develop a conceptual framework for PES in SA.

1.4 Research methodology

The research methodology is summarised in Figure 1.1. A detailed literature study was done to identify and investigate different types of PES methods used globally. A key informant e-mail survey was conducted amongst 25 forestry and environmental experts. This included managers of forestry companies, foresters, environmental managers and academics. This was followed by a Delphi study among a small number of experts. The data collected was used to develop a conceptual framework for PES for commercial forestry plantation in SA.

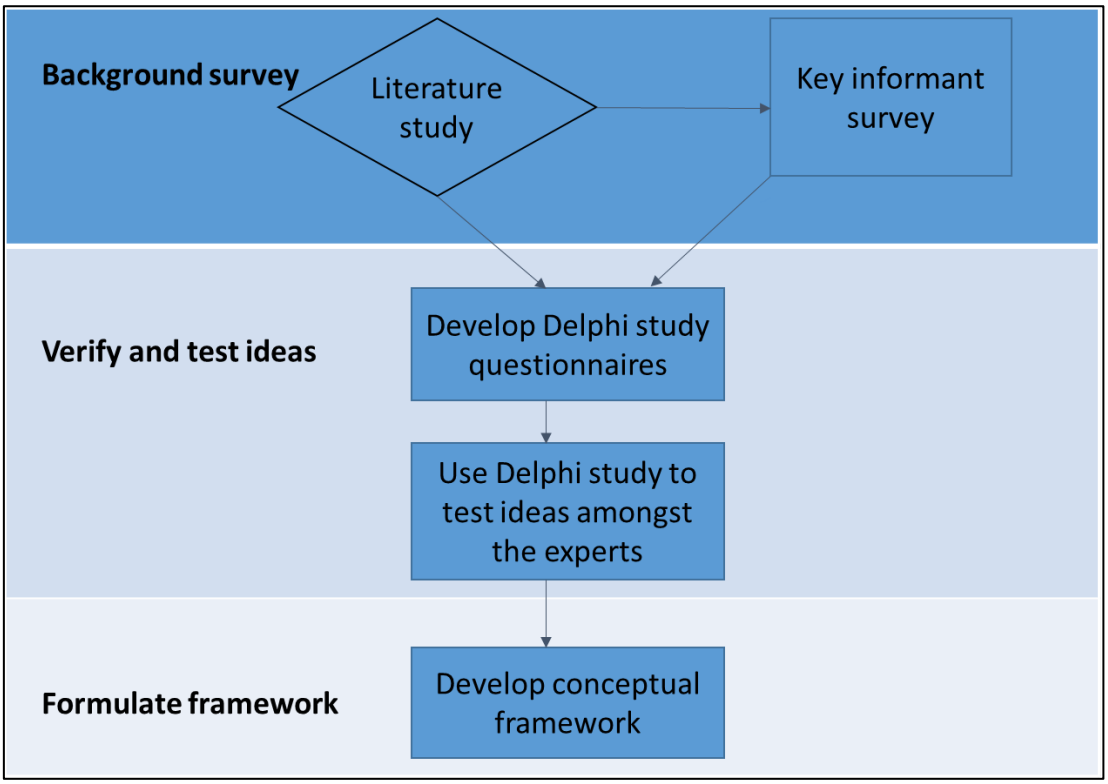

Figure 1.1: Flow diagram of methodology.

1.5 Research structure

The thesis is divided into six chapters. Chapter 1 provides an introduction to the study. Chapter 2 provides a detailed literature review, while Chapter 3 explains the materials and methods used during this study. Chapter 4 presents the results, and Chapter 5 discusses the results. Chapter 6 highlights the main conclusions, with a summary of recommendations for future studies.

Chapter 2: Literature review

2.1 Plantation forests

2.1.1 Introduction

Plantation forests are even-aged stands containing trees of similar age, size and condition characterised by a simple structure (Bauhus & Schmerbeck, 2010). They are defined as wooded lands or forests of introduced species established by planting or seeding introduced tree species in the method of reforestation or afforestation (Brockerhoff *et al*., 2008). The trees are planted primarily for wood biomass production, for water and soil conservation, or for wind protection (Carnus *et al.*, 2006; Kanninen, 2010). Plantation forests are becoming more important as countries move to produce maintainable sources of wood fibre to meet the demand for wood pulp and energy (Carnus *et al.*, 2006).

2.1.2 Plantation forests in South Africa

In SA there are about 1.27 million ha of forest plantations, representing only 1.1% of the land area (SABIE, 2020). According to the estimation by Department of Agriculture, Forestry and Fisheries (2012), about 83% of the total tree plantation area is owned by the private sector, whereas government plantations belonging to the South Africa Forestry Company (SAFCOL) represent only 17% of the planted area. About 50% of plantation areas are covered by pines, while the rest of the planted trees are species such as eucalypt and wattle. The total plantation forest use of the country's water resources is estimated at 3% (SABIE, 2020).

Apart from producing wood and fibre, plantations are becoming more important for providing several other environmental goods and services, such as carbon sequestration, clean water production and regulation of hydrological cycles (Kanninen, 2010; Pokorny *et al*., 2010). In addition, they play a similar role to natural forests in providing numerous benefits to human society, such as food, fodder, medicinal resources, timber, fuelwood, and ornamental and recreation opportunities (De Groot & Van der Meer, 2010). Previously, the roles of tree plantations were not clear regarding their impact on ES. With the increasing demand for wood production, plantations serve their production function in a very effective way. Many environmental services declined where natural vegetation was replaced by plantation trees, and therefore it is the scarcity of ES that necessitates the need for PES schemes. However, when degraded or former agricultural land was used to establish plantations, various ES improved as a result (Bauhus *et al*., 2010). Plantations have also been criticised by some for their negative environmental and social effects (Maginnis & Pollard, 2006).

2.1.3 Productive and protective plantations

Ecosystem functions are defined as "the capacity of natural processes and components to provide goods and services that satisfy human needs directly or indirectly" (De Groot, 1992). The functions of plantation forests are diverse. De Groot and Van der Meer (2010) and Kanninen (2010) divide plantation forests into two sub-groups, which are protective plantations and productive plantations. They further explain that productive plantations focus primarily on producing industrial wood, non-wood products and fuelwood, whereas protective plantations mostly intend to protect and to provide conservation, control water quality, sequestrate carbon, control soil erosion, provide recreation, recover degraded land and combat desertification. According to Keenan and Van Dijk (2010) and

Kanowski (2010), plantation forests provide economic, social and environmental benefits, including watershed-protection benefits. Keenan and Van Dijk (2010) further explain that, in many regions with limited water, such increased protection enables expansions in irrigated land that help sustain a growing population. Critchley and Bruijnzeel (1996) also believe that plantation forests have more economical advantages over natural forests. These indicate that the species planted in plantation forests are much more productive as they produce more timber and fuel wood.

2.2 Environmental services provided by plantation forests

Forests have become a key pillar of greenhouse gas mitigation to fight climate change. This has also significantly increased the importance of plantations (Böttcher & Lindner, 2010). Initially, plantation forests were established mostly for the production of wood products such as timber, charcoal and pulp. However, currently they also supply other services, such as carbon sequestration, biodiversity, erosion control and water regulation (Bauhus & Schmerbeck, 2010). These ES provided by plantations play an important role in human wellbeing (Sattler & Matzdorf, 2013).

Ecosystems provide the life support system of our planet, but over the past several decades the goods and services that they provide have been degraded significantly (Kubiszewski *et al*., 2017). ES have economic importance, but the value of these ES and goods are rarely incorporated into the ES market system, which has resulted in the overexploitation and degradation of natural forests (De Groot & Van der Meer, 2010). Sattler and Matzdorf (2013) believe that there are some ES markets that are functioning very well, whereas many environmental services are still outside the current market system because they exhibit the features of public good resources and lack property rights. Water, carbon storage, biodiversity, landscape beauty and carbon sequestration are environmental services that are more marketable than others (Blignaut *et al*., 2008). According to Ranacher *et al*. (2017), when environmental services lack a market price, it is difficult for such services to break through in the forestry sector.

2.2.1 Types of environmental services and their links to ecosystem functions

In order to understand the capacity of ecosystems to provide goods and services of value to human society, it is important to translate ecosystem structures and processes into goods and services using the notion of ecosystem functions (De Groot & Van der Meer, 2010). Without ecosystem functions, environmental services and goods cannot exist. Environmental services are benefits people obtain from the natural environment, such as the regulation of surface water (Nyongesa, 2017), whereas ecosystem goods such as food represent the benefits the human population derives directly or indirectly from the ecosystem functions (De Groot & Van der Meer, 2010).

According to De Groot *et al*. (2002), there are a wide range of ecosystem functions and their associated goods and services. Island Press (2006) conveniently grouped ecosystem functions into four primary categories: regulation functions, production functions, information functions and habitat functions.

2.2.1.1 Regulation functions and related environmental services in plantations

Regulation functions regulate essential ecological processes and life support systems through biochemical cycles and other biosphere processes (De Groot *et al*., 2002). These functions provide many services with direct and indirect benefits to humans, such as clean air, water and soil, nutrient regulation, disturbance prevention, and biological control (De Groot & Van der Meer, 2010). According to Nyongesa (2017), regulating services lack a direct market, but they play an important role in supporting provisioning services such as household food security.

- **Air quality regulation**

The main services provided by air quality regulation functions are the maintenance of clean, breathable air, and the prevention of diseases (e.g. skin cancer); in other words, the general maintenance of a habitable planet (De Groot *et al*., 2002). Plantations provide clean air by capturing dust particles and CO_2 (De Groot & Van der Meer, 2010).

- **Climate regulation**

Climate regulation influences local and global climate through land cover and biologically mediated processes in order to provide greenhouse gas balance (De Groot & Van der Meer, 2010). Plantation forests have high carbon storage compared to many native forests. They produce wood at a higher rate, which has made them significant for carbon investments (De Groot & Van der Meer, 2010). According to Böttcher and Lindner (2010), five strategies have been identified for the contribution of the forestry sector. The strategies are to increase forest area; to increase the existing carbon stock; to protect existing stocks; to increase carbon stored in products; and to replace fossil fuels with bioenergy from forest biomass and wood. Böttcher and Lindner (2010) further reviewed approaches to be used in forest-based sectors to strengthen carbon sequestration and mitigate climate change, while maintaining other environmental services such as drinking water, space for recreation, and the supply of timber and non-timber products.

Forest planted trees absorb CO_2 from the atmosphere and store it in biomass (Mayrand & Paquin, 2004). According to Chaudhury (2009b), forests can store at least one billion tonnes of CO_2 annually, thereby acting as carbon sinks. However, carbon sequestration in the forest-based sector is a temporary strategy, as trees harvested from plantations without re-establishment do not contribute further to carbon sequestration (Böttcher & Lindner, 2010).

- **Water regulation and supply**

Plantation forests can offer different types of services that can affect surface watercourses, water bodies and the amount of water accessible for use from groundwater. They can assist with the regulation of water flow by buffering excess discharge into rivers (Chaudhury, 2009a; De Groot *et al*., 2002). Plantations play a role in water filtration, retention and storage in streams, lakes and aquifers (Blignaut *et al*., 2008). The function of water filtration is performed by vegetation cover and biota. Plantations offer the retention and storage of water, which also depends on topography and sub-surface characteristics of the environmental services involved. Plantations also offer a water-supply function, depending on the role of environmental services in hydrologic cycles, and provide water for consumption, such as drinking, irrigation and industrial use (De Groot *et al*., 2002, Blignaut *et al*., 2008).

- **Soil retention**

The function of soil retention depends on the structural aspects of environmental services, most importantly on root systems and vegetation cover. Compaction and erosion of bare soil can be prevented by trees stabilising the soil and foliage intercepting rainfall. Soil erosion and sedimentation can be controlled by plants growing along the edge of a lake or river in a plantation. Plantations also play a role in preventing landslides (De Groot & Van der Meer, 2010). The services provided by this function are very important to maintain agricultural productivity and prevent environmental, agricultural or human damage due to soil erosion (De Groot *et al*., 2002).

- **Nutrient cycling**

Environmental services resulting from nutrient cycling are mostly linked to the maintenance of healthy and productive soils. Furthermore, nutrient cycling plays an important role in the regulation

of gas, climate and water functions (De Groot *et al*., 2002) and offers the services of maintaining a healthy soil and productive ecosystem (Blignaut *et al*., 2008)

- **Plant pollination**

Plantations provide refuge for the pollinators of plants, including of commercial crops. This function is critical for the cultivation of most modern crops and protects many plant species from becoming extinct (De Groot *et al*., 2002).

2.2.1.2 Production functions and related environmental services in plantations

Production functions provide natural resources by supplying products and goods such as timber, fibre or non-wood forest products (De Groot *et al*., 2002; Blignaut *et al*., 2008). Plantations provide many resources – from oxygen, water, food, medicinal and genetic resources to sources of energy and materials for clothing and building (De Groot *et al*., 2002). Below are the ecosystem functions with their related environmental services and goods found in plantation forests.

- **Food**

Plantation forests provide foods from cultivated plants such as nuts, sugar cane and coffee (De Groot & Van der Meer, 2010). Forests also play a role in the conversion of solar energy into edible plants (Blignaut *et al*., 2008) and by serving as pollen sources for honey production (Elzaki &Tian, 2020).

- **Raw materials**

Plantation forests provide raw material such as timber and fibre (De Groot & Van der Meer, 2010). They also provide other renewable biotic resources, such as wood for building, and biochemical or biodynamic compounds such as latex, waxes, oils, gums, tannins and dyes. Plantations also supply energy resources, like fuel wood, organic matter and biochemicals, such as ethanol and hydrocarbons, and food for animals, such as grass and leaves (De Groot *et al*., 2002).

- **Genetic resources**

Genetic material from plantation forests can provide genes for resistance to plant pathogens (De Groot & Van der Meer, 2010).

- **Ornamental resources**

Plantation forests provide many kinds of raw materials that are used for fashion and clothing, and for handicrafts (e.g. wood for carving) (De Groot *et al*., 2002).

2.2.1.3 Information functions and related environmental services in plantations

Information functions provide opportunities for cognitive development (De Groot *et al*., 2002). The services linked to this function contribute to humans' mental wellbeing (De Groot & Van der Meer, 2010). Services related to informational functions in forests have aesthetic and recreational uses.

- **Aesthetic information**

Plantation environments provide aesthetic qualities to the landscape based on their structure, diversity, and greenness (De Groot & Van der Meer, 2010). Many people enjoy the scenery of both natural areas and plantation landscapes (De Groot *et al*., 2002). Plantations are not known for high levels of biodiversity, but provide areas of scenic beauty (Chaudhury, 2009a). The services provided by landscape beauty are frequently linked with the cultural value given to specific sites. These services may also involve the protection of cultural sanctuaries and natural heritage sites (Mayrand & Paquin, 2004).

- **Recreation and ecotourism**

Plantation ecosystems provide opportunities for tourism and recreational activities whereby people can go for rest, relaxation, refreshment and recreation (De Groot & Van der Meer, 2010). Plantations are able to provide many opportunities for recreational activities, such as walking, hiking, camping and fishing, depending on their aesthetic qualities and the variety of landscapes (De Groot *et al*., 2002). The ecotourism industry is potentially one of the main beneficiaries of landscape beauty services (Mayrand & Paquin, 2004). Ecotourism plays a role in protecting the biodiversity that is found in forests within protected areas and provides a cultural service, which will satisfy socio-cultural purposes and help protect landscapes as well (Chaudhury, 2009b).

- **Scientific and educational information**

Opportunities for studies and scientific research are also provided by plantation ecosystems. However, these functions do not provide environmental services. They provide formal and informal education and training about the ES and related information (De Groot & Van der Meer, 2010; De Groot *et al*., 2002).

- **Spiritual and artistic inspiration**

Plantation environments provide opportunities for spiritual enrichment, mental development and leisure, but this can be limited by short-term rotations (De Groot *et al*., 2002). Although these functions do not provide environmental services, they play a role in human wellbeing and are used for religious or historic purposes (Blignaut *et al*., 2008).

2.2.1.4 Habitat functions and related ES in plantations

Suitable living space for wild plants and animal species can be provided by plantations. They also play a role in supporting all the other services (De Groot *et al*., 2002; Blignaut *et al*., 2008). Just like regulating services, supporting services lack a direct market. However, supporting services play an important role in supporting provisioning services (Nyongesa, 2017).

Plantation forests provide the minimum critical surface area of a specific habitat (De Groot & Van der Meer, 2010). According to Brockerhoff *et al*. (2008), although plantation forests cannot provide a more suitable habitat than natural forests, there is abundant evidence that plantation forests can provide valuable habitat and contribute to the conservation of biodiversity through various mechanisms. Biodiversity is vital for environmental functioning and supports all other environmental services. It also contributes to the wellbeing of humans by providing insurance against disturbance; and habitat benefits to humanity (Bauhus & Schmerbeck, 2010; Ranacher *et al*., 2017; Forest Stewardship Council [FSC], 2020b).

2.3 The effect of plantation forests on environmental services

Environmental services are public goods, making it very difficult to manage, conserve and protect them from being misused (Landell-Mill & Porras, 2002). According to Kanowski (2010), the effect of plantation forest on ES may vary, both spatially and temporally, reflecting its landscape context, its design and composition, and its management. According to Geldenhuys (1997), commercial plantations have both negative and positive effects on the environment, which also depend on the context in which they are planted and how they are managed.

2.3.1 Positive effects of plantation on environmental services

Plantation forests play an important role in reducing harvesting pressure on natural and semi-natural forest (Bauhus *et al*., 2010; Paquette & Messier, 2010). According to Ham (2000), the supply of firewood and poles from tree plantations contributes significantly to reduce the deforestation rates of natural forests. The use of plantation forests to restore connectivity in fragmented landscapes is one of the positive effects on ES. Afforestation and catchment management can reduce soil erosion and surface run-off (Kanowski, 2010).

Plantation forests can provide clean water production, hydrological cycle regulation, the mitigation of desertification and improve the connectivity of landscape mosaics for biodiversity conservation (Kanninen, 2010). Plantation forests can also mitigate soil erosion and sequester atmospheric carbon (Kanowski, 2010). Trees provide protection for the soil by reducing the direct effect of rainfall, and their roots also provide a litter layer which support understorey growth and surface roughness (Keenan & Van Dijk, 2010).

Plantation forests also play a role in reducing global net carbon emission through carbon sequestration, whereby CO_2 is removed from the atmosphere, captured by the trees through photosynthesis and stored as carbon in biomass (Paquette & Messier, 2010; Ingram *et al*., 2016). According to Osuri *et al*. (2020), monocultures of highly productive planted tree species used in commercial plantations capture carbon at the same rate as more species-rich communities in natural forests, but natural forest areas store a higher amount of carbon stocks in the living biomass and in the soil compared to planted forests (Besar *et al*., 2020).

Planted trees play a major economic role through the provision of productive plantation products such as timber and fibre. These various ES can be provided through knowledge and experience by properly planning, designing and managing forest plantations, at both the landscape and stand scales (Bauhus *et al*., 2010). Plantation forests can increase biodiversity in landscapes that might otherwise contain only a monoculture of agricultural crops (Ingram *et al*., 2016). Plantations can also provide a buffering effect on the edges of natural forests, whereby plantation forests may increase the value of indigenous forest remnants (Brockerhoff *et al*., 2020).

2.3.2 Negative effects of plantations on environmental services

As much as plantation forests play a role in protecting and conserving ES, planting crops can cause soil disturbance during plantation establishment and during harvesting and timber removal (Critchley & Bruijnzeel, 1996; Kubiszewski *et al*., 2017). Loss of biodiversity or aesthetic value caused by conversion of the landscape scale from natural landscapes to plantation forests is one of the adverse effects caused by plantations (Kanowski, 2010).

Poor forest management practices can have a large effect on soil structure and water quality (Kanowski, 2010). Fire has been identified as one of the significant hazards of forest plantations, especially in areas with an extended dry season and where large amounts of litter shed by deciduous trees constitute a readily available source of fuel (Critchley & Bruijnzeel, 1996). Most plantation forests have less habitat diversity and complexity compared with indigenous vegetation. For example, there may be a lack of over-matured trees suitable for bird nesting, and some bird species may not find their food source in plantation forests (Brockerhoff *et al*., 2008). Plants and animals that are used to natural forest may not be able to colonise or reproduce in plantations with relatively short rotations (Brockerhoff *et al*., 2008). Plantation forests play a role in decreasing overall water yield and flow, which have important consequences for aquatic life and downstream users (Rosoman, 1994).

Conservationists has been criticising the replacement of natural forests with tree plantations because of their lack of biodiversity (Maginnis & Pollard, 2006). Plantation species may become

invasive species (Ingram *et al*., 2016). Chemicals used during afforestation may run off into streams, with negative ecological effects (Ingram *et al*., 2016). A study by Maginnis and Pollard (2006) indicates that forest plantations that are converted from grasslands eliminate freshwater lenses. They also found that the observed salinisation depends strongly on the soil texture and not on the tree species planted (Maginnis & Pollard, 2006).

2.4 How is the effect being balanced?

Plantation forests are neither integrally good nor bad; rather, it is the choices made by humans on how to use them that determine their effect on the environment (Maginnis & Pollard, 2006). Forestry companies around the world have committed themselves to improving their environmental performance. More than 80% of South African plantations, for instance, are certified according to the Forest Stewardship Council (FSC) certification standard (Shackleton *et al*., 2007).

Plantation forests can have a positive effect in areas that are affected by negative environmental impacts. In areas that are degraded and have high erosion rates, the planting of trees can reduce soil loss through organic matter build-up and protection from wind erosion, the effect of rainfall, ice needle erosion and sheet wash (Rosoman, 1994). On balance, plantations are able to establish a system that, with careful management, can provide a suitable alternative to the nutrient cycle of natural forests (Kubiszewski *et al*., 2017). Biodiversity in plantations can be increased by choosing the best management methods regarding composition and structure (Brockerhoff *et al*., 2008). Planting a larger number of tree species can improve the diversity of habitat and therefore increase the number of dependent species (Brockerhoff *et al*., 2008).

Around the world, many forestry owners and companies are committed to improving their environmental performance and restore important environmental services through PES (NGP, 2015). For example, plantations have adopted certain practices to increase ES in their plantation forests. Such practices include appropriate site preparation to decrease soil disturbance and increase the retention of nutrients, increase soil organic content to limit carbon emissions, and increase coarse woody debris (Paquette & Messier, 2010).

Sustainable management practice in plantation forests can play a role in minimising the negative effects on environmental services and enhance the level of ES supplied from plantations. This can be done through having an appropriate governance framework to govern working conditions for an equitable distribution of benefits to relevant stakeholders. Sustainable management can also be achieved by having stakeholder consultation and sufficient application of well-established knowledge. In addition, sustainable management can be achieved through the maintenance of environmental sustainability and forest health, and the recognition and maintenance of social and cultural values. Lastly, having an integrated plan can minimise the negative effects on ES through the management and maintenance of landscape-scale diversity, which can be achieved through the use of intensive plantations that involve a mosaic of monocultures of different species (FAO, 2010; Paquette & Messier, 2010). With diligence and planning in policy, plantations can be a long-term investment – especially in management practices – in order to avoid negative impacts. Therefore, the selection of germplasm, nursery production, establishment, site preparation, tending, weeding, silviculture, protection and harvesting intervention needs to be managed properly in order to maximise ES in the plantation forests (FAO, 2010).

Plantation forest companies in SA have designed environmental guidelines for commercial plantations that reduce their effect on ES structures. The purpose of these guidelines is to promote the management of plantation forestry and include statutory requirements and best management practices to minimise the effect of forestry operations on the environment (FSA, 2019). This is to ensure compliance with legislation and the implementation of best management practices (FP&M

SETA, 2014). The plantation forests in SA use three percent of the country's total water resources and do not utilise irrigation for forest plantation management (FP&M SETA, 2014).

Stakeholders in the SA forestry industry are also committed to implementing and maintaining sustainable plantation forests. They do so by practising resource-efficient forestry operations, protecting and identifying natural areas with high conservation value, such as wetlands, grasslands and natural forests, and they also consider the social values of forests and related ecosystems (FP&M SETA, 2014). This is done by promoting sustainable land use and ensuring improved management of scarce water resources. The latter is done by delineating wetlands and riparian areas in existing plantations and removing the alien and invasive species from the buffer zones inside the wetland. The timber plantations are then withdrawn from the wetland buffer zone (FSA, 2019; Sherbut, 2011). Plantation owners also must have valid water-use licences and pay water-usage levies. The purpose of this is to cover the soil water taken up by timber plantations, along with the loss of rainwater as a result of evapotranspiration (FSA, 2021).

2.5 The importance of payment systems for environmental services

Direct compensation to forestry companies and local farmers could motivate them to look after natural resources. Payment for environmental services is used as an approach to manage ES by way of cash payments or other forms of compensation, or rewards to motivate environmental conservation and restoration (Milder *et al*., 2010; Hayes *et al*., 2017). Watershed protection, carbon sequestration and storage, biodiversity protection and landscape beauty are the four most common environmental services with ongoing payment schemes (Wunder, 2005). PES is a voluntary transaction between at least one voluntary buyer and one voluntary provider of ES, whereby the buyer pays for well-defined services provided by the service provider, but only if the provider continues to supply those services conditionally, or reverses degradation, to achieve conservation goals (Jack *et al*., 2008; Borges, 2011; Blundo-Canto *et al*., 2018; Khanal & Devkota, 2020). Conventionally, PES is defined as a voluntarily transaction between the provider and ES users not limited to markets to generate off-site services, on the condition that the resource user provides said service (Blundo-Canto *et al*., 2018).

Human pressure on natural ecosystems is rising and environmental services previously provided 'for free' have become scarcer, which increases the scope for PES (Wunder, 2005). According to Pagiola *et al*. (2004), the principle of PES is that people who are providing the ES should be compensated for providing these services, and people who are receiving them should pay for the services they are receiving. According to Biénabe *et al*. (2017), PES are customary practices and mechanisms used to protect forests. Payment for environmental services is based on direct incentives, contracts and conditional remuneration, which have also attracted the interest of institutions and development agencies. They were also designed to promote the production of ES that have no markets or are free, such as public goods that include biodiversity and scenic beauty, or collective goods that include water quality in a watershed (Biénabe *et al*., 2017).

According to the United Nations (UN), PES is a strategy to preserve ES in order to safeguard biological conservation and to avoid agricultural land-use pressure (Da Silva *et al*., 2017). Payment for environmental services was also designed and introduced to save forests from being abused and for landowners to use ES wisely (Miranda *et al*., 2003; Laurans *et al*., 2012). Farmers and communities benefit from PES through compensation for good work in preserving ES. The system benefits them by contributing to their cash income. It also expands their knowledge of sustainable resource-use practises, improves the resilience of the local environment and the flow of ES, and helps them to produce more from their land (FAO, 2007; Waage *et al*., 2008).

The efforts to develop a payment mechanism for environmental services have increased and are regarded as an indicator of the rising monetary value of ES. Payment for environmental services plays a role in addressing the disproportion between the public costs of avoiding deforestation and the generation of private income through the conservation of forests (De Groot & Van der Meer, 2010).

2.5.1 Current global state of payment for environmental services

Across the developing world, PES is becoming popular and is being used as a financial tool to support forest conservation (Corbera *et al*., 2009). Countries like Mexico, Costa Rica, El Salvador, Brazil and the United States of America have been implementing PES systems since 1990. Costa Rica is also known as the pioneer of PES implementation in the forestry sector (Budhi *et al*., 2016). In countries such as Mexico and Costa Rica, payments have been offered to farmers in exchange for reserving areas on their farms for establishing tree plantations in order to assist in promoting forest regeneration. The farmers also receive an annual payment from central government funds for managing plantations and foregoing additional agricultural income in exchange for the establishment of plantation forests (Sherbut, 2011).

In Mexico, PES has been established as a hybrid instrument that also includes a form of subsidy to fight poverty in rural areas and targets the most marginal communities (Biénabe *et al*., 2017). The cultural values and existing rules in Mexico also motivate people to participate in PES conservation projects willingly, favouring conservation. This indicates that PES can certainly strengthen organisations that exist for environmental conservation and provide a motivation for behavioural change (Corbera *et al*., 2009). However, in the case of PES in Costa Rica, beneficiaries of environmental services are not recognised on the basis of criteria for exploiting ES or deforestation risk, and payments are not handled in the way that separates them according to opportunity costs and the ability to provide ES (Biénabe *et al*., 2017).

According to Biénabe *et al*. (2017), there is no comprehensive design for PES; however, the concept has spread worldwide, and considerable experience has been accumulated and should be consolidated. Systems for PES have been developing slowly as a spontaneous response with great potential. Countries such as China have developed PES programmes in terms of which their governments pay their rural communities and farmers for the provision of ES though tree planting and the maintenance of forest cover in critical watersheds. The Chinese government has also put in place self-sustained PES initiatives that involve private companies and NGOs as buyers and sellers of ES (Corbera *et al*., 2009).

2.5.1.1 PES schemes for payment for carbon sequestration

Markets in carbon are fundamentally worldwide in range and most of their transactions involve international buyers. Carbon sequestration markets are well established and very competitive (Mayrand & Paquin, 2004). Such carbon sequestration services are also involved in different market transactions in the world and include several PES schemes (Mayrand & Paquin, 2004). Payment for environmental services for carbon sequestration involves paying the service provider for increasing the carbon stock of their land by planting trees. For example, in Uganda there is a tree for global benefit project whereby small-scale landholder farmers receive a reward for increasing the carbon stock on their land through tree planting. In Uganda, the Nile Basin Reforestation project provides climate services in the form of certified greenhouse gas emission reductions, and the community is involved in managing forest reserves to achieve the goals (FAO, 2016).

2.5.1.2 PES schemes for biodiversity services

The variety of biodiversity services can create many demands, which will increase the difficulty of creating payment systems. However, the value of biodiversity conservation services is difficult to determine. Biodiversity services are not sold directly, but indirectly through particular land uses that are supposed to protect species, genetic diversity and ecosystems (Mayrand & Paquin, 2004). For example, in Guyana, the government has signed an agreement for a conservation concession with Conservation International (Mayrand & Paquin, 2004). A private venture called Kibale Forest Wild Coffee in Uganda pays the farmers in Kibale premium prices to provide them with sustainably grown coffee. The communities in Kibale are also committed to practising conservation that mitigates the threat to biodiversity in both the core conservation zone and the buffer zone. In Costa Rica there is a programme aimed at generating both biodiversity conservation and carbon sequestration benefits through a PES scheme, whereby farmers are paid to plant up to 80 000 trees under agroforestry contracts in buffer zones (Pagiola, 2008). These schemes provide a self-sustaining incentive for biodiversity conservation in agricultural landscapes (FAO, 2016).

2.5.1.3 PES schemes for landscape beauty

Ecotourism is one of the main beneficiary industries with a potential, and thus a demand, for landscape beauty services (Mayrand & Paquin, 2004). There are few suppliers of landscape beauty services, and thus far governments have been the main suppliers of such services. Schemes that involve payment for environmental services that are involved in the provision of landscape beauty services are very few and difficult to quantify based on their cultural foundations. Nevertheless, landscape beauty services are gradually being introduced in PES schemes with the purpose of stimulating tourism (Mayrand & Paquin, 2004). In Ecuador, tourism operators pay local communities not to hunt in a forest used for tourist wildlife viewing (Wunder, 2005). In Costa Rica, a rafting company pays farmers for landscape service, whereby the farmers are paid not to remove trees to protect a viewing shed from a hotel (Pagiola, 2008).

2.5.1.4 PES schemes for watershed services

Land users in water catchment areas are in the position to receive benefits from water users in cities through PES schemes (Buric *et al*., 2011). In order to finance the management of protected areas upstream, watershed-based services are frequently subsidised through user fees. Various countries in Latin America and the Caribbean, such as Brazil, Colombia, and Costa Rica, have developed strategies to improve their upper watershed management for water service maintenance (Mayrand & Paquin, 2004). Some examples include:

- New York City has established a system to protect its drinking water sources, with fees for water having been increased by nine percent in the city in order to invest in the protection of the Catskill and Croton Watersheds (Mayrand & Paquin, 2004).
- Pimampiro municipality in Ecuador has established a payment system for the Palaurco River upper watershed that delivers drinking water (Wunder & Albán, 2008).
- The Ecuadorean Corporation for the development of renewed natural resources has also designed a PES proposal as part of its forest management plan (Mayrand & Paquin, 2004).
- In the Cauca Valley in Colombia, a PES system was initiated by farmer associations with regard to the sustainable supply of water for irrigation (Mayrand & Paquin, 2004; Keenan & Van Dijk, 2010).

- In Costa Rica, utility companies have a fund that pays private upstream landholders for increasing forest cover in order to provide water flow regulation for hydroelectricity generation (Keenan & Van Dijk, 2010).
- In Mexico, the government funds a payment for hydrological environmental services (PSAH) programme that aims to preserve water supplies and is financed from a portion of the revenue generated from water-use fees (Engel *et al*., 2008).

2.5.2 Current state of environmental services payments in SA

Forestry companies certified by the Forest Stewardship Council are already playing a role in preserving ES and also bear the associated costs (FSC, 2020a). The FSC has launched a new ecosystem procedure that will be used to protect environmental services (FSC, 2020a). The procedure aims to create incentives for the preservation of ES such as water, carbon, biodiversity, soil and recreational services.

FSA has developed environmental guidelines for commercial forestry plantations in South Africa. The guidelines focus on implementing the best environmental management practices in SA to help in assisting timber growers by minimising the effects on biodiversity. The guidelines help to establish ecological corridors between timber compartments and the management of unplanted land to improve biodiversity conservation. It recommends mitigating effects on streamflow reduction by removing invasive and alien species and withdrawing plantations from wetland buffer zones. It also recommends reducing the negative effect on the soil, mainly on harvested compartments and proper road construction and maintenance (FSA, 2019). This guideline was designed to provide guidance on how to reduce negative effects and guide the companies to comply with environmental laws.

According to FSA (2020), SA claims the highest degree of forest certification in the world on the basis of achieving certification of 80% of FSC timber plantations. The forestry industry in SA takes pride in its environmental, social and economic responsibility (FSA, 2020). Most of the plantation forests in SA are FSC certified (FSA, 2018). Those that are not FSC certified are mostly small-scales growers who lack the financial means to pay for the certification process. A new national certification system has been registered in the country, viz. the South African Forestry Assurance Scheme (SAFAS). This scheme was initiated to cover the needs of small-scale timber growers who cannot afford FSC certification (FSA, 2018). The scheme is endorsed by the Programme for Endorsement of Forest Certification (PEFC).

In SA, research on PES proposes that the restoration of natural environments and sustainable land-use management can yield good economic returns (Sherbut, 2011). The growth in the scarcity of ES in SA creates a new market for forestry, where environmental services, such as carbon sequestration and watershed management, are being traded (Mander, 2012). Currently, there is no proper PES system in the country; however, there are a number of projects to protect ES, such as the Working for Water (WfW) programme. This is a government-funded project that provides services by clearing mountain catchment and riparian zones of invasive alien plants. This is done to conserve water in riparian zones and mountain catchments (Turpie *et al*., 2008).

The South African government developed the Working for Water programme to provide environmental benefits while directly fighting poverty issues. The aim of the project is to fight poverty by providing temporary work and skills development on watershed improvement projects that also largely involve the removal of invasive alien plants (IAP) (Porras & Neves, 2006). Although most of the funding used in water management comes from the government's poverty relief fund, water users also pay for water through the government's water management fees. The project has been working very well, with about one million hectares of IAP being cleared between 1999 and 2006. This has

yielded an estimated release of 48 to 56 million cubic metres of additional water per annum (Porras & Neves, 2006).

The development and evolution of Working for Water, Working for Wetlands, Working on Fire and Working for Woodland programmes in SA have paved a way for introducing PES in the country (Blignaut *et al*., 2008). The conservation planners in SA are also looking to PES as potentially playing a role in realising conservation initiatives. South Africa and Lesotho have signed a treaty to transfer 780 000 million litres of water between the two countries. South Africa pays royalties to Lesotho for providing water from the Senqu River system to the water-stressed Gauteng region. This agreement stipulates environmental protection and the sustainability of the river system (FAO, 2016).

The Cederberg conservancy in SA has a stewardship programme in central Cederberg that unites 22 farming properties as one of the essential corridors of the greater Cederberg Biodiversity Corridor. The landowners have an agreement amongst themselves to manage the environment sustainably, whereby the landowners who commit their property to the stewardship option enjoy the benefits of joining a stewardship programme that includes physical benefits from the conservation action (FAO, 2016).

2.6 Different types of payment for environmental services

There are many different types of PES schemes. Wunder (2005) has categorised them into three distinct types: area vs. product-based schemes, public vs. private schemes, and use-restricting vs. asset-building schemes. All the PES schemes differ in the vehicles used to achieve conservation or restoration effects. According to Swallow and Meinzen-Dick (2009), most of the PES schemes focus more on carbon sequestration and the protection of existing carbon stocks, biodiversity conservation, landscape restoration, watershed protection, and rehabilitation. The aim of PES schemes is to connect ES providers, such as environmental managers or local communities playing roles in protecting the ES, to ES buyers or direct or indirect beneficiaries of ES in contract-like arrangements (Sattler & Matzodorf, 2013).

2.6.1 Area- vs. product-based schemes

Area-based schemes are the most common PES scheme. This is where land contracts are stipulated for a pre-agreed number of land units. For example, it is used in conserving concession easements, and protecting catchments or forest-carbon plantations (Wunder, 2005, 2007). According to Adhikari and Boag (2013), the service price signal of area-based schemes depends on market access and price fluctuations of the “host” commodity, which also makes it less clear compared to product-based schemes. Area-based PES schemes may be mostly useful if ES sellers are allowed to bundle services through the conservation or protection of a piece of land that could yield multiple and higher payments. In product-based schemes, on the other hand, a ‘green premium’ is paid by consumers for a production scheme (such as, for instance, organically grown coffee) that is certified to be friendly based on environmental factors (Wunder 2005, 2007; Singh, 2013).

2.6.2 Public vs. private schemes

Payment for environmental services also differs according to who the buyers are. In public schemes (e.g. in Costa Rica, Mexico, China), the state acts on behalf of ES buyers by collecting taxes and grants and paying ES providers. Private schemes focus more on the local communities and buyers pay for the services directly (e.g. watershed schemes in Pimampiro-Ecuador, Valle del Cauca-Colombia, Santa Rosa-Bolivia, and virtually all carbon schemes) (Wunder, 2005, 2007). In Asia, PES mechanisms reflect either public payment schemes or private payment schemes. In Indonesia, for

instance, an eco-tourist company or a local water-bottling plant pay upstream land users for the provision of improved water quality or quantity in the form of direct or indirect cash payments (Huang & Upadhyaya, 2007). Also in Indonesia, government-owned or municipal water-supply companies reduce sedimentation through incentives or cash payments to upland communities in return for the provision of reliable water flows and improved water quality (Huang & Upadhyaya, 2007). Compared with private schemes, public schemes have the state providing legitimacy and are usually bigger in scope. Public schemes can be overloaded with side objectives rather than supplying ecological services properly (Wunder, 2005, 2007).

2.6.3 Use-restricting versus asset-building schemes

Use-restricting PES schemes are used for conservation rewards. The providers receive rewards for capping resource extraction and setting aside areas such as protected habitats. In these schemes, the landowners are paid for their conservation opportunity costs and for possibly active protection efforts against external threats (Wunder, 2005, 2007). With use restriction, PES has largely focused on avoided deforestation and afforestation (Sarkissian *et al*., 2017), versus asset-building schemes, which focus on restoring an area's environmental services, such as (re)planting trees in a degraded landscape. Conservation-opportunity and protection costs aside, PES may also compensate the direct costs of ES establishment through agricultural system investments (Wunder, 2005, 2007).

Asset-building schemes such as reforestation require long-term maintenance to ensure the future additionality of off-farm ES. Such programmes have delayed benefits and have high short-term costs, which can be a fundamental issue of concern to PES buyers who are worried about the long-term delivery of ES. In order for asset-building schemes to work, there must be a mixture of both results and action-based payments over time to cover the high initial costs while making sure there is tree retention (Sarkissian *et al*., 2017).

2.7 Payment for environmental services schemes

Due to the ability of PES schemes to mobilise new funds in order to conserve ES and to achieve development outcomes, the interest in PES schemes has grown strongly. However, from the economic efficacy perspective, there must be a balance on welfare, direct check and equity as well as payments for PES schemes to work. The value of the services provided must be based on the ES value, without cheating the provider (Biénabe *et al.*, 2017). If the providers of the service feel that they will be disadvantaged by the deal, they are unlikely to participate and vice versa.

Payment for environmental services must provide a 'win-win' opportunity for both the provider and the buyer of the service in order for them to work. These services can be structured by including a robust and credible business case and an accurate estimate of costs, including transaction costs, in order for them to be successful. This can be done by making sure that the payment is high enough to fully cover all costs, incentivise the seller to provide the service over the long term, and ensure that income from alternative land uses is set off. Therefore, it is important to include the two main mechanisms for PES, which are performance-based payments and input-based payments. According to Fripp (2014), performance-based payments are only made if the actual ecosystem service is provided. These payments are for elements such as a certain amount of carbon sequestration, along with a measured increase in biodiversity or an improvement in water quality. In the ideal situation, performance-based payments would be the basis of all PES schemes. Input-based payments, on the other hand, are defined as payments being made for the implementation of certain land- or resource-management practices. One example is the creation of buffer strips along watercourses. These types of payments, however, will only work if buyers are willing to accept that

inputs/activities that are specified will result in the desired ecosystem service being provided (Fripp, 2014). PES schemes can provide a strong incentive and can also be an effective framework for consultation, cooperation, and policy development. They can be a vehicle for the sustainable delivery of ES, provide a mechanism for compensating forest communities, owners and managers who maintain ES, and help engage local communities and indigenous people in conservation and sustainable development opportunities (Biénabe *et al*., 2017).

Schemes that involve PES can help improve forest law enforcement and governance, since the services being paid for need to be monitored. The improved land and forest tenure systems and control mechanisms established under robust PES schemes discourage illegal activities while generating sustainable incomes for tenure holders (Navarro, 2014; Biénabe *et al*., 2017). PES cases can be referred to as PES schemes or PES projects. However, PES schemes are designed to last longer, and they are characterised by a permanent, sustainable solution for the ES challenges compared with a project, which has a limited duration (Buric *et al*., 2011). Biodiversity, landscape preservation, carbon sequestration and water protection are the most common environmental services to be used in PES schemes (Brouwer *et al*., 2011).

2.8 Challenges of PES systems and their effectiveness

According to Alix-Garcia *et al*. (2005), more than 300 PES schemes were inventoried worldwide in 2002. Although there has been an increase in the number of such projects, there is a lack of rigorous studies analysing the effectiveness of such projects in providing ES and the effects they have on the communities and people receiving the payments (Alix-Garcia *et al*., 2005). PES schemes have been agued to be challenging when evaluating the opportunity costs and ES delivery. These schemes occasionally also cause conflicts over land-use rights. There further are technical issues when it comes to measuring and verifying concrete environmental results. The issue can be a lack of well-structured beneficiaries, and a lack of communication among land users and ecosystem suppliers. There can be challenges relating to PES transition costs, such as initial contracting, monitoring and verification, financial guarantees, etc. Transaction costs, which are also defined as all costs associated with buying and selling in a market, are an important part in making PES scheme work The way in which transaction costs are placed can affect the market. With a growing evidence of transaction costs within PES mechanisms that it might be higher than anticipated, this may contribute to failure of a project. It is difficult to also find the buyers and sellers that are willing and match up with their interests. Another challenge comes with resolving institutional, legal and technical issues which also require significant time and expertise (Fripp, 2014).

Market conditionalities that the sellers and buyers must follow can make it difficult for PES system to work. Such as complying with the requirement of relevant voluntary carbon markets when the seller want to sell carbon credits which also need to be verified. This may result in sellers/buyers incurring additional costs (Fripp, 2014). Both buyers and sellers of ES must be satisfied with the price set. Whereby, the stakeholders or sellers must receive enough to cover the costs of the project and have extra to motivate them and ensure the permanence of the ES.. Other options for providing ES must be expensive for buyers and sellers to ensure that the buyers or sellers sees alternative land uses, or business as usual, as inferior options to providing the ES. (Fripp, 2014). However, PES schemes have proven to work better when services are visible, ecosystem service suppliers and beneficiaries are well organised, and when land-user communities are well structured and have clear and secure property rights with strong legal frameworks (Buric *et al*., 2011). The lack of competitive PES rates due to the provision of environmental services being difficult is one of the challenges that could discourage people from joining conservation schemes. However, some farmers exploit PES

schemes by cashing in on rent for forests or land that they would have conserved regardless (Wunder, 2005).

Initially, PES was designed for private exchange and did not involve governments and donor agencies. Involving government and donor agencies has caused many challenges around PES systems, such as budget constraints, political processes and payments that are likely to end at some point (Kerr *et al*., 2017). According to Wunder *et al*. (2010), there are four main issues that can affect PES effectiveness. These are non-compliance with contractual conditions; poor administrative selection; spatial demand spill-overs; and adverse self-selection.

Non-compliance among PES programme participants may compromise PES due to the costs that come with monitoring and compliance (Börner *et al*., 2017). Poor administrative selection can also affect the effectiveness of PES contracts that might be offered to individuals who are not suitable to supply ES efficiently, especially if the government is involved. Spatial demand spill-overs can affect PES effectiveness, whereby the protection of resources in a particular location puts pressure on resources located elsewhere (Wunder *et al*., 2010). The effectiveness of a PES system can be influenced strongly by paying ES providers for the actual outcomes, such as additional tons of carbon stored, rather than paying for the action of not clearing the forests (Börner *et al*., 2017). Paying for outcomes can benefit PES programmes more than paying for actions, which can also be uncertain. In addition, paying for outcomes may also decrease the risk of moral hazard, since monitoring the actions of programme participants is costly (Börner *et al*., 2017).

2.9 Designing an effective conceptual framework

Paying for environmental services comprises a number of options. There are also different ways in which such payment can be established and how it is most appropriate to finance it. In all cases it is necessary to identify an appropriate ecosystem service, based on solid scientific data. However, it is only possible to establish PES if both a buyer and a seller recognise the value of the service and the appropriate infrastructure for the transaction (marketplace) is established. There are lot of processes to be followed and considered for PES to be effective, and these include identifying an appropriate ES, identifying suitable buyers and sellers, and establishing the appropriate marketplace (Fripp, 2014).

This study aimed to develop a workable conceptual framework (CF) based on the information gained from the literature and through key informant surveys. The framework set out the design for an integrated programme, whereby its practices would also be influenced by the socioeconomic attributes of specific PES interventions (Nyongesa, 2017). According to Engel (2016), PES design is a complex task and therefore there is a need to deal with this complexity by understanding specific ecological and socio-economic contexts. The challenges that come with PES need to be understood in order to develop a workable and user-friendly CF. The framework to be designed has to be able to empower communities by increasing their engagement. According to Khanal and Devkota (2020), increasing the roles and responsibilities of key stakeholders in ES has influenced people to pay for environmental services that traditionally were considered to be free – this strengthens preparedness for the sustainability of the ES (Khanal & Devkota, 2020).

Chapter 3: Materials and methods

3.1 Introduction

Plantations provide environmental services such as carbon sequestration, clean water production and regulation of hydrological cycles. However, there are also concerns about the increasing development of large-scale plantations in response to the increasing demand for wood. This study aimed to define the concepts and review different types of PES schemes that are currently active, to investigate the positive and negative effects on ES associated with commercial plantations, to identify possible buyers and sellers of ES, to investigate the impact of compensations and penalties on ES in commercial forestry plantations, and to develop a conceptual framework for PES in SA.

A detailed literature search was done to determine PES systems suitable for plantation forests and ES provided by plantation forests (Chapter 2). This formed the background to key informant interviews with environmental practitioners in the SA forestry industry. The focus was to understand the conditions, the views and the actions of plantations stakeholders, foresters and environmental specialists in relation to PES in SA plantations and the protection of ES (Bless *et al*., 2006). Key informant and Delphi surveys were chosen for this study based on the need to gather more information about PES and to understand the opinions of other ES experts and foresters.

The study used a combination of quantitative and qualitative methods to collect data. Qualitative methods are used to collect non-numerical data and focus more on understanding and describing (Babbie & Mouton, 2001). Data was collected in the form of a survey. This was done to gain access to research subjects and to gather more information about plantation forests in SA through in-depth descriptions and understanding of actions and events. The quantitative data was used in descriptive statistical analysis and comparisons (Babbie & Mouton, 2001).

The research design consisted of:

- Key informant interviews: Information was gathered through an e-mail questionnaire (Appendix A) sent to 45 environmental practitioners and environmental experts in the SA forestry industry. The aim was to gain more information about the current relationship between ES and plantation forestry and PES. This survey created background information for a Delphi study amongst a small group of experts.
- Delphi study: The data from the key informant survey was used to formulate a questionnaire (Appendix B) and to identify an expert panel for the Delphi study. A Delphi study is defined as a systematic, iterative process that is used to elicit, distil and determine a consensus view among the members of a panel from a given field of experts, where predictions or decisions are made using the expert opinions of the panellists involved in the study (MacCarthy & Atthirawong, 2003; Nworie, 2011). In this study, a three-round Delphi method was adopted. In the first round there was an opportunity for experts to add topics that had not been included and to brainstorm (Hasson et al., 2000). During the second round, feedback was given based on the first-round responses, whereby the panel was given an opportunity to review their scoring in the light of the average results. In the third round, the experts were informed of the results from round two and were asked to review their scoring in the light of the average results (Day & Bobeva, 2005).
- Development of a conceptual framework: The data collected from the key informant and Delphi surveys was used to construct a conceptual framework.

The unit of analysis for the key informative survey and the Delphi survey was individual persons (Bless et al., 2006). Individual persons were chosen based on their familiarity with the subject to be

studied. The individuals provided their knowledge on PES, their opinions and their views. Selecting individuals from different fields was done to ensure a balance of information from different fields.

3.2 Key informant survey

A key informant survey was conducted to gather the introductory information needed to design a comprehensive quantitative study. The key informant survey helped to gather more information on plantation forests in SA and their services, before conducting a Delphi study survey. Some of the participants in the Delphi study were recommended by key informant participants during the survey.

- The Forestry South Africa (FSA) Environmental Committee assisted in identifying relevant environmental practitioners in the SA forestry industry. Key informants were selected using purposive sampling (Babbie & Mouton, 2001). Forty-five people were selected from among forestry professionals and environmental experts to participate in the survey.
- The questionnaire survey was conducted via electronic mail in order to communicate with the participants, who were in various areas. Since people were also busy, the email method allowed the participants to respond in t their own time. The method is inexpensive and saved money (Babbie & Mouton, 2001).
- The questionnaire used both open-ended and closed-ended questions. In an open-ended question, participants are given freedom to respond in a way they want and can explain in detail without limitation (Babbie & Mouton, 2001). However, in closed-ended questions, the participants choose the most suitable answer. The questionnaire was the same for all the participants to ensure similar types of information to be compared. The questionnaire was formulated and presented according to the four study objectives. The content behind the questions was to identify how people feel and think and to learn what they know and what they do not know (Robson, 2002).
- The questionnaire was tested among a selected group of three foresters and three environmental specialists. The people selected were familiar with the subject of the study. They were asked to complete the questionnaire to see if they understood the questions and further examine the questionnaire to determine if the questionnaire was appropriate. Adjustments were made where questions were ambiguous or not clear. The questionnaire was submitted to and approved by the Stellenbosch Research Ethics Committee.
- The questionnaire was distributed to the 45 participants via email. Email was used in this survey for reasons of being practical and inexpensive (Babbie & Mouton, 2001). The questionnaire document consisted of a cover letter explaining the aim of survey, and an assurance of confidentiality (Robson, 2002). There are ethical considerations when collecting data, especially for participants who want to remain anonymous, and the participants were assured that their information would be treated with confidentiality (Bless et al., 2006). A period of one month was set aside to allow for feedback from the participants. The number of returns were recorded continuously and follow-up emails were sent out to remind non-respondents of the importance of their participation (Robson, 2002).
- The key informant survey was done to gain more knowledge on the interaction between ES and the SA forestry industry. Responses were analysed in Microsoft Excel and results expressed as descriptive statistics. This analysis involved coding and grouping answers. Since the questionnaire consisted of both closed-ended and open-ended questions, open-ended questions were coded accordingly in order to be analysed clearly (Babbie & Moutons, 2001).
- The survey data, together with the literature, provided the background for the development of a Delphi questionnaire and a draft conceptual PES framework.

3.3 Delphi study

The Delphi technique was used to test the draft conceptual framework and to collect information and opinions from ES experts (Skulmoski *et al*., 2007; Nworie, 2011). This was done with the aim of improving group decision-making by seeking opinions without face-to-face interaction. Although panel members in Delphi studies are separated by time and space, they were able to engage in the same project in their own time and at their own pace without influencing the opinions of others (Nworie, 2011). The survey helped to improve understanding of the problem and to develop a proper CF.

- The panel members were identified during key informant interviews using the chain referral method (Explorable, 2009). This was done by asking key informants to provide information needed to locate other members of a targeted group they knew. The chain of referral was done through exponential non-discriminative snowball sampling, whereby all the key informants were asked to refer people that they knew who had similar interests (Explorable, 2009). The panel members selected were knowledgeable and familiar with the subject to be studied, which helped build credibility into the results of the study and ensure the quality of responses, as well as to reduce bias in the results of the study (Nworie, 2011).
- The survey was done through email questionnaires. In this study, the email method was considered the best option since participants were based in different areas. Since people are also busy, the email method allowed the participants to respond in their own time. The study used a semi-structured questionnaire that was compiled based on the information provided by the key informant interviews. In order for the Delphi study to be successful, the questionnaire was designed to focus on problems, solutions, opportunities and forecasts. The questionnaire consisted of open-ended questions (Nworie, 2011). It was completed anonymously by the panellists, who did not meet face to face.
- The questionnaire was tested amongst a selected group of forestry postgraduate students. This was done to identify errors and to test if the questions were constructed properly and in an appropriate manner (Babbie & Mouton, 2001). The group that did the testing was asked to complete the forms rather than only look for errors. The Delphi survey and questionnaire were approved by the Stellenbosch University Research Ethics Committee.
- A three-round method was adopted in the Delphi study. According to Day and Bobeva (2005), the number of Delphi rounds varies from two to 10, but they are most commonly restricted to two or three rounds. The questionnaire developed in this study consisted of 12 open-ended questions. The questionnaire was sent to eight experts (who were contacted beforehand and asked to participate via email), but only six experts responded and participated in the survey. Responses were then summarised and presented according to each question.
- In the second round of the Delphi study survey, new questions were developed based on responses from the first round. The responses from the first questionnaire were fed back by summarising them and reporting them back to the experts (Hasson et al., 2000). The respondents were given an opportunity to review their scoring in the light of the average results and were asked to share their ideas and recommendations. This second round of the Delphi study survey consisted of six open-ended questions and the same six experts who participated in the first round of the Delphi survey were invited to participate again via email. Only five experts responded. The responses were summarised and presented according to each question.

- In the third round of the Delphi study survey, the experts were informed of the results from round two and were asked to review their scoring in the light of the average results (Day & Bobeva, 2005). As part of the process, the responses from each questionnaire were summarised and sent back to the participants in the form of a report (Hasson et al., 2000). Since the study depended on the information collected from the participants, it was important for the participants to maintain their involvement until the end of the process (Hasson et al., 2000). Follow-up emails were sent to the non-respondents, encouraging them to participate (Babbie & Mouton, 2001). The participants were also reminded of the importance of their opinions on and recommendations for the study. In the last survey round, the same five experts who participated in the second round were asked to participate in this survey via email and they all participated. The questionnaire included three questions in order to reach common agreement between the respondents and clarity on what to recommend. Responses were summarised, analysed and presented according to each question. The various rounds of the Delphi survey are demonstrated in the diagram in Figure 3.1.

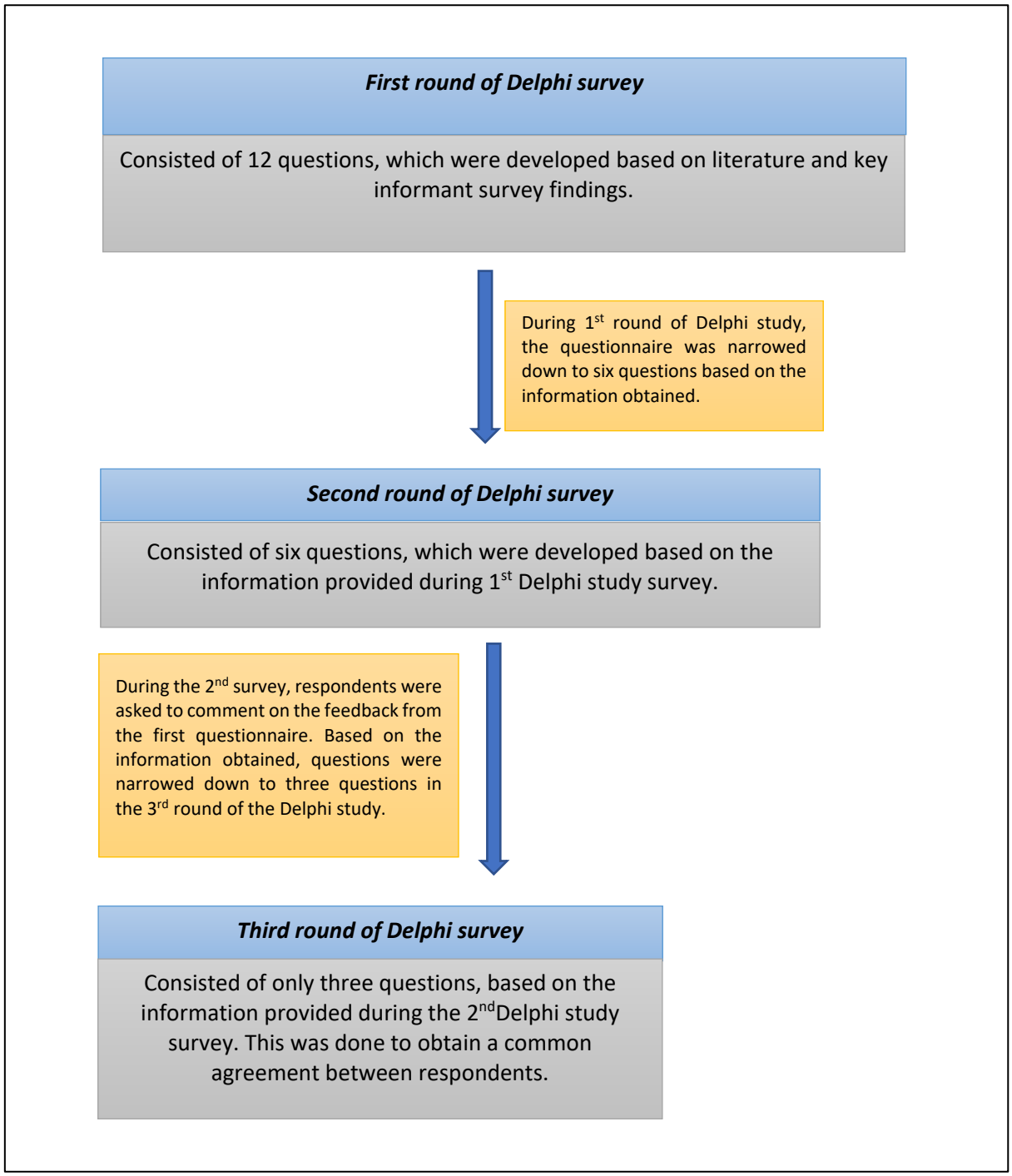

Figure 3.1: Delphi study process.

3.4 Development of a conceptual framework

In the third phase of the study, the data collected during the key informant survey and the Delphi study survey was used to develop a conceptual framework (CF) for PES in forestry in SA. The CF was developed as a guide to the best PES practice suitable for plantation forests in SA. A CF is defined as a network of linked concepts that provide a complete understanding of a phenomenon when they are linked together (Jabareen, 2009). Additionally, a CF is an analytical tool with several variations and contexts. It is used to come up with conceptual distinctions and to establish concepts.

In this study, the CF was developed to clarify the concepts and to encourage theory development, which is useful in practice. It also defines the relevant variables and how they relate

to each other. The CF was constructed and developed based on the literature review, questionnaire survey and Delphi study. In developing the CF, other variables that might influence the relationships between the elements of a PES were identified and expanded on (Swaen, 2020). A CF is another way of providing an understanding without offering a theoretical explanation (Jabareen, 2009). There are many different designs that can be used in developing a CF in research studies (Adom *et al*., 2018). A simple example of a CF on child literacy research is presented below (Figure 3.2)

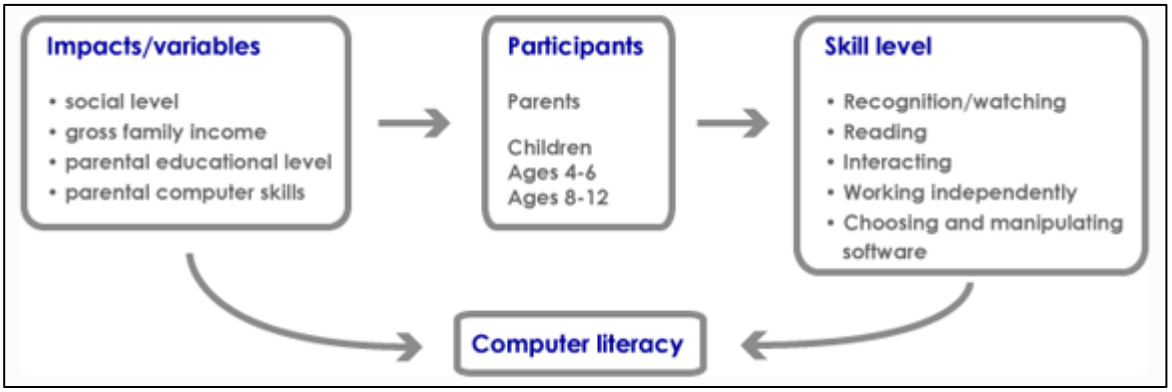

Figure 3.2: Conceptual framework for child literacy research (Monash, 2020).

According to Jabareen (2009), CF is not merely a collection of concepts, but rather a construct in which each concept plays an integral role. The grounded theory methodology was used to develop the framework for the CF. According to Chun Tie *et al*. (2019), grounded theory is used to generate theory by discovering or constructing theory that is grounded in the data. Grounded theory is particularly important for building a CF because of its primary characteristics. Furthermore, because of its use of method that conforms to good science, the grounded theory perspective is one of the most widely used qualitative interpretative frameworks (Jabareen, 2009).

Chapter 4: Research results

4.1 Introduction

The results from the questionnaire survey and Delphi study are presented as a first step in addressing the study objectives and developing a conceptual framework for payment for environmental services in South Africa. This chapter has three parts: a key informant survey, a Delphi study and the development of a CF.

4.2 Key informant questionnaire survey

Responses to the questionnaire survey provided background to the current status of ES and PES in SA. In the section below, the responses are summarised and presented according to each question. A total of 25 responses were obtained from the 45 respondents. According to Babbie and Mouton (2008), a 50% response rate is acceptable for analysis and reporting, while 60% is a good response rate. Therefore, the 55% obtained in this survey was deemed acceptable.

4.2.1 Environmental services from plantation forests in SA

The participants were asked to rate environmental services in their plantation forests according to the categories of very relevant, some relevance and irrelevant. The weighted responses are depicted in Figure 4.1 (1 = irrelevant and 10 = very relevant). The provisioning of raw materials (9.2) and carbon sequestration (8.9) were rated as the most relevant ES found in plantation forests, followed by energy resources (8.6) and climate regulation (8.5). Both recreational use (7.9) and nutrient cycle (7.8) were found to be very relevant. In addition, air quality (7.4) and water supply (7.4) were equally rated as relevant services. Services indicated to have some relevance were plant pollination (6.8), genetic resources (6.6) and waste treatment (6.4). Hazard regulation was identified as the least relevant ES in plantation forests, with a ranking of 4.9.

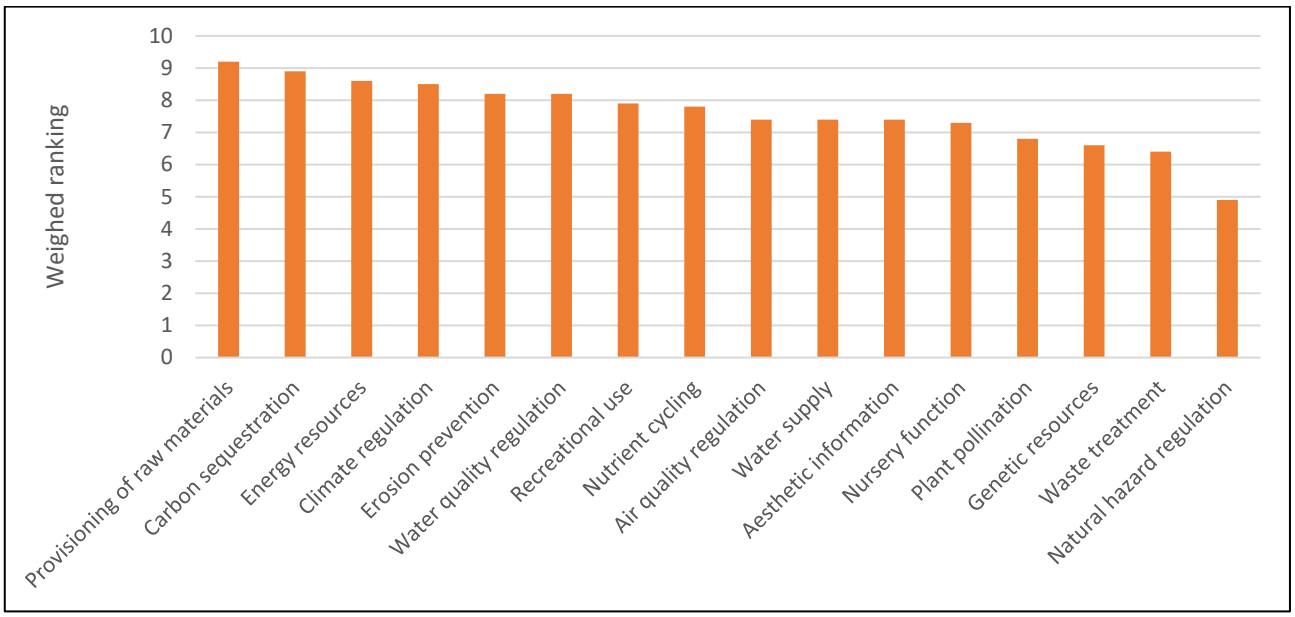

Figure 4.3: A summary ranking out of 10 of environmental services that are available in the respondents' plantations (1 = irrelevant and 10 very relevant) (*n* = 25).

4.2.2 Improving the supply of environmental services in plantations

All respondents (*n* = 25) agreed that operations in plantations can improve the supply of ES. Nearly half of the respondents (48%) believed that good plantation management can improve the supply of ES in the form of better quality of runoff water (28%), and improved soil quality, erosion control, and carbon sequestration (24%). Respondents (12%) also indicated that job creation and the provision of, for instance, fuelwood from plantations can improve ES by reducing the pressure on other natural resources (Figure 4.2).

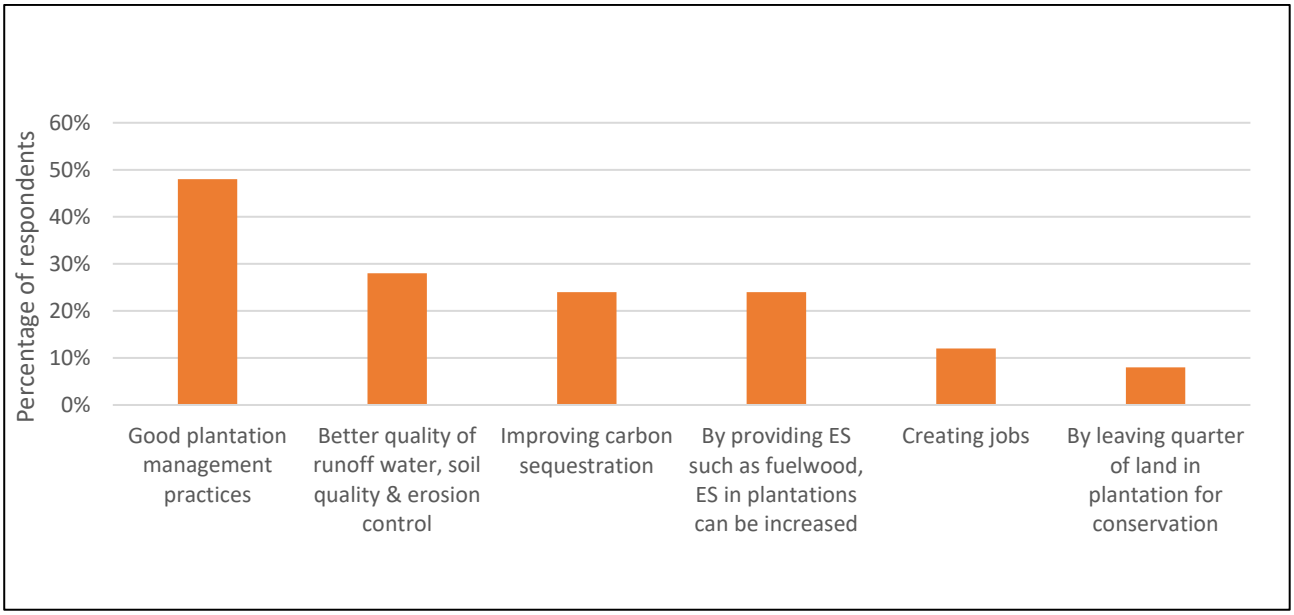

Figure 4.4: A summary of how plantation operations can improve the supply of ES (*n* = 25).

4.2.3 Negative effect of plantation forests on environmental services

All 25 participants agreed that operations in plantations can negatively affect the supply of ES, and most respondents (*n* = *20*) gave more detailed information about the type of effect. More than half of the respondents who provided more details (55%) believed that operations in the plantations can cause a decline in water provisioning and supply. This was followed by detrimental soil erosion and soil damage (35%) (Figure 4.3). Some respondents (30%) also felt that establishing a new plantation can decrease biodiversity and reduce the supply of ES, such as surface area for specific habitat and medical resources for the local community.

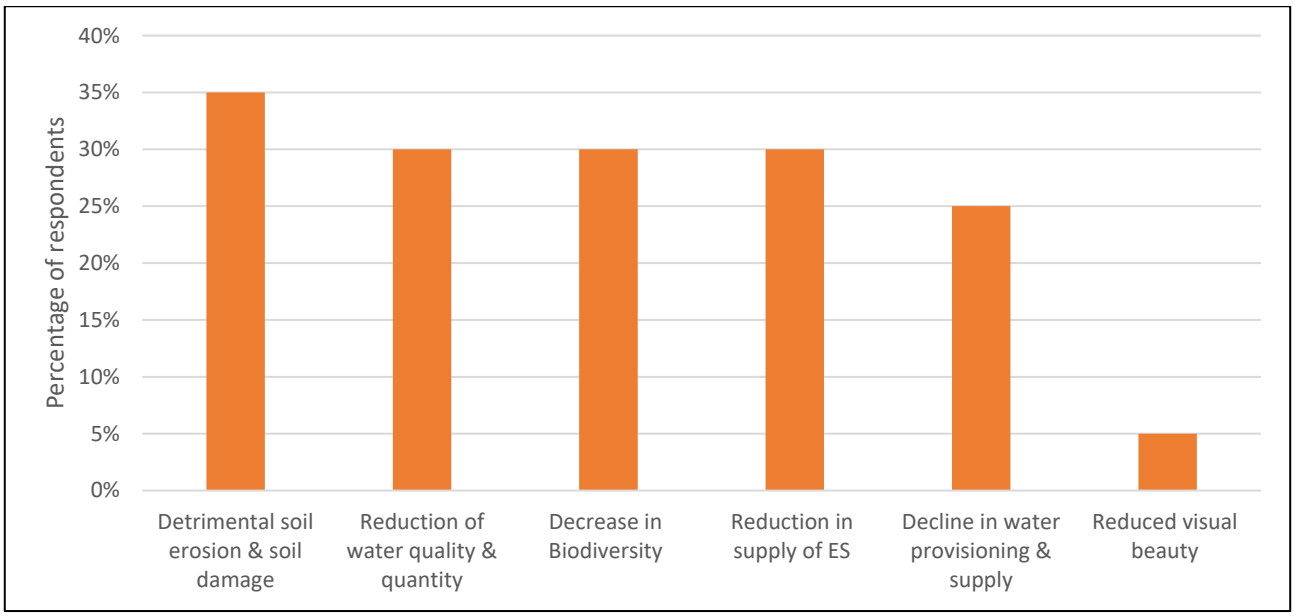

Figure 4.5: A summary of types of effect on ES that can be caused by plantation forest (*n* = 20).

Most of the respondents (68%) believed that poor management of the plantation was the cause of the negative effect on ES, while some respondents (23%) also felt that poor management of water, such as planting in a watercourse and uncontrolled stormwater run-off, played a role in influences ES. Only 18% indicated that poor planning and environmental practices played a role in increasing negative effects on ES (Figure 4.4).

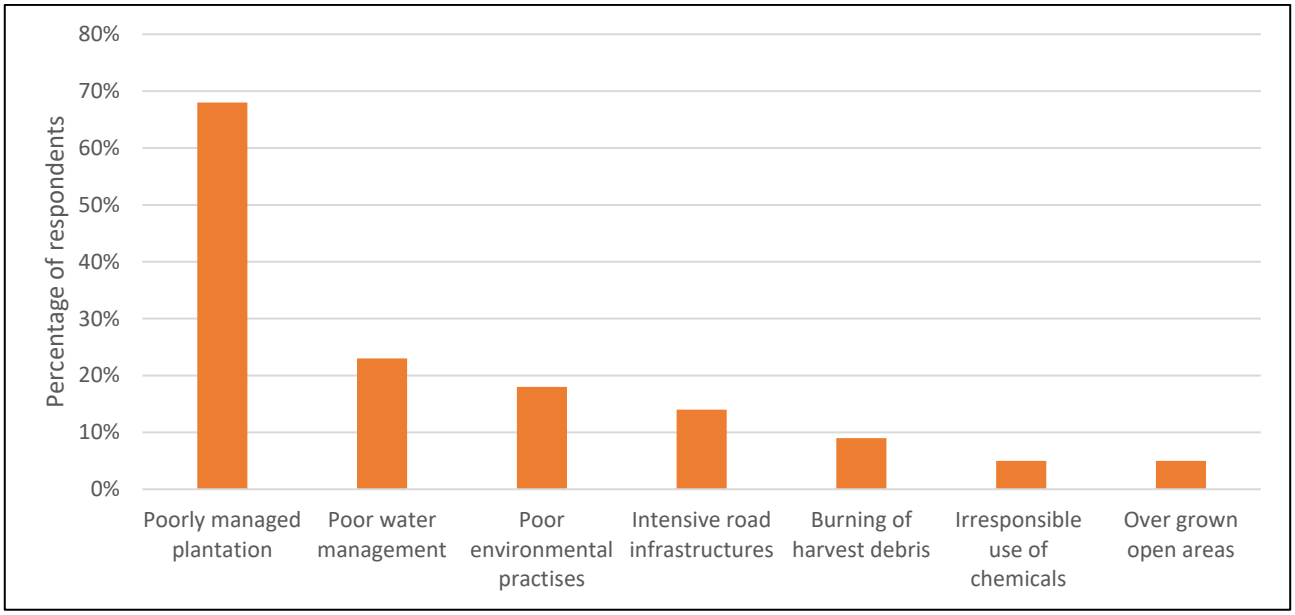

Figure 4.6: A summary of plantation activities that negatively affect the supply of ES (*n* = 22).

4.2.4 Minimisation of negative effects of plantation operations on supply of environmental services

More than half of the respondents (56%) indicated that potential negative effects of plantation operations on the supply of ES could be minimised through proper, sustainable environmental management (Figure 4.5). Sixteen percent of the respondents stated that adhering to legislation and

procedures can minimise the negative effect of plantation operations on the supply of ES, and 16% said reputable certification schemes and education on the importance of ES can minimise impacts.

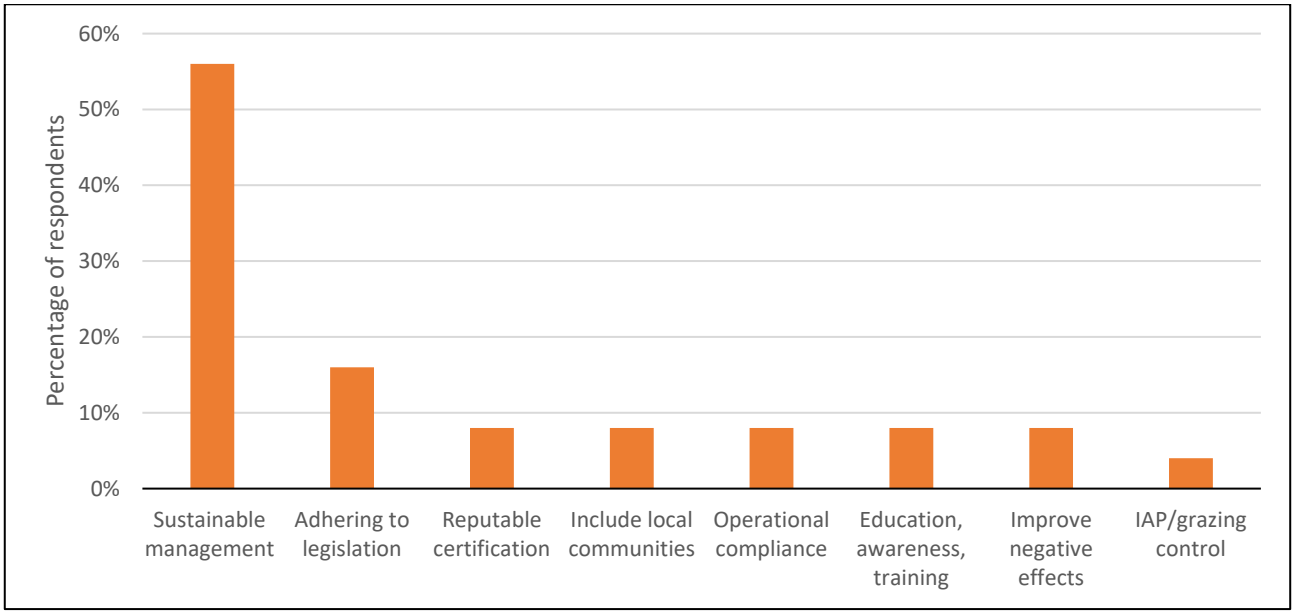

Figure 4.7: A summary of how potential negative effects of plantation operations on the supply of ES can be minimised (*n* = 23).

4.2.5 Enhancement of positive effects of plantation operations on the supply of ES

Participants were asked how to enhance the positive effects of plantation operations on the supply of ES. Good management was highlighted by 50% of the participants as the best way of enhancing ES in plantations. Furthermore, 21% of respondents indicated that educating workers and employing candidates with forest plantation backgrounds can positively enhance the supply of ES. Some respondents (12%) believed that implementing proper management standards could positively enhance the supply of ES.

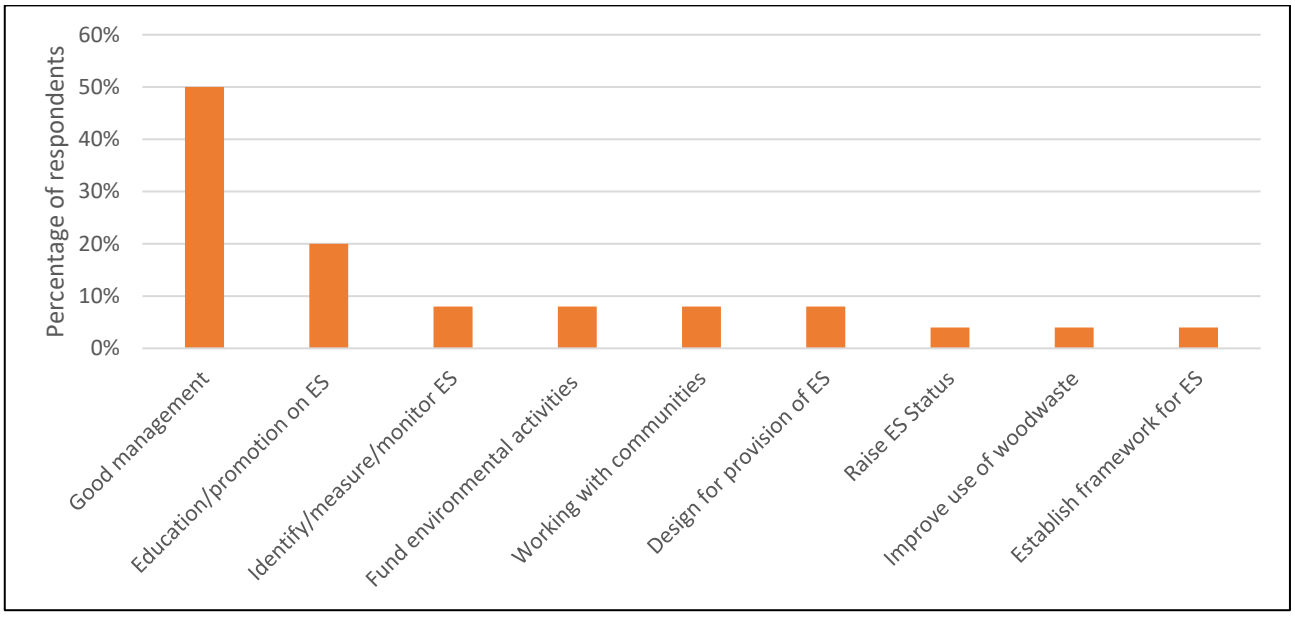

Figure 4.8: A summary of how to enhance positive effects of plantation operations on the supply of ES (*n* = 24).

4.2.6 Monitoring the supply of ES in plantation forests

Participants were asked if their companies monitored the supply of ES in plantations. Nearly half of the respondents (48%) indicated that their companies did so, and 45% mentioned that their companies were currently FSC certified (Figure 4.7). Companies also monitor though permit systems (18%), annual open areas, and under-canopy IAP surveys (9%).

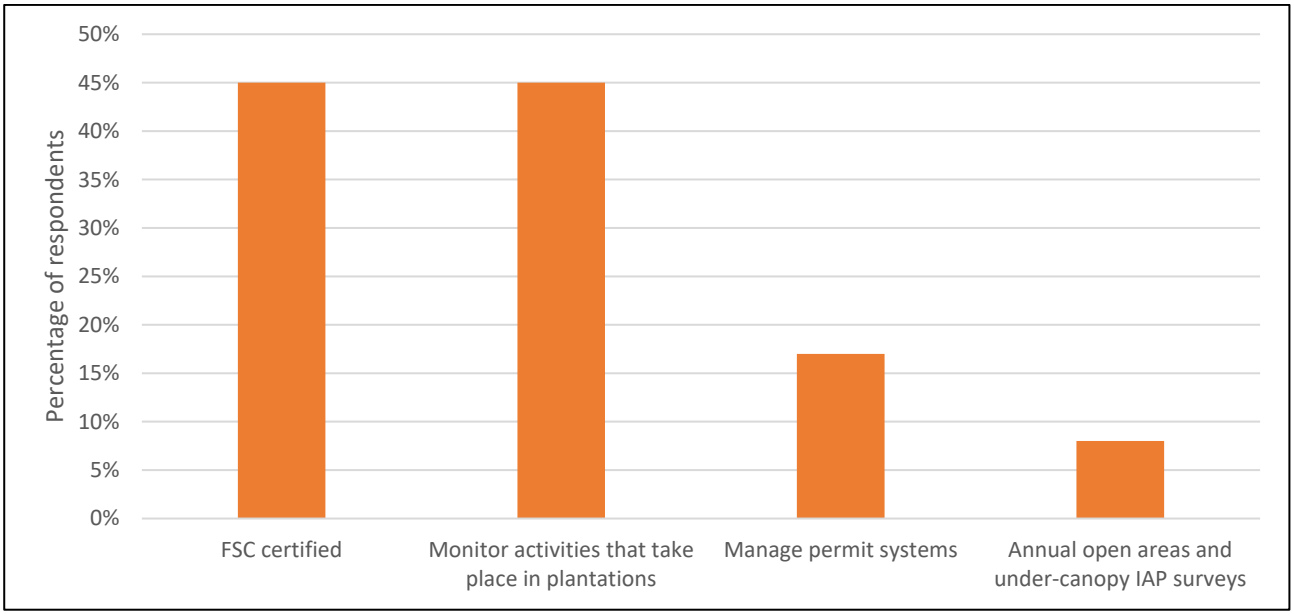

Figure 4.9: Ways of monitoring the supply of ES in plantation forests (*n* = 11).

4.2.7 The beneficiaries of environmental services from plantation forests

Participants were asked if they knew who benefits from ES in their plantations and were given categories to select from that included the local community, national government, tourists, private entities and company workers. Most of the respondents (96%) (*n* = 23) stated that local communities around plantation forests are the beneficiaries of the environmental services supplied by plantations (Figure 4.8). This was followed by 83% of respondents stating that company workers are the beneficiaries, 65% stating that tourism is the beneficiary, and 52% stating that national government, the local municipality and private entities are the main beneficiaries of the ES supplied by plantations.

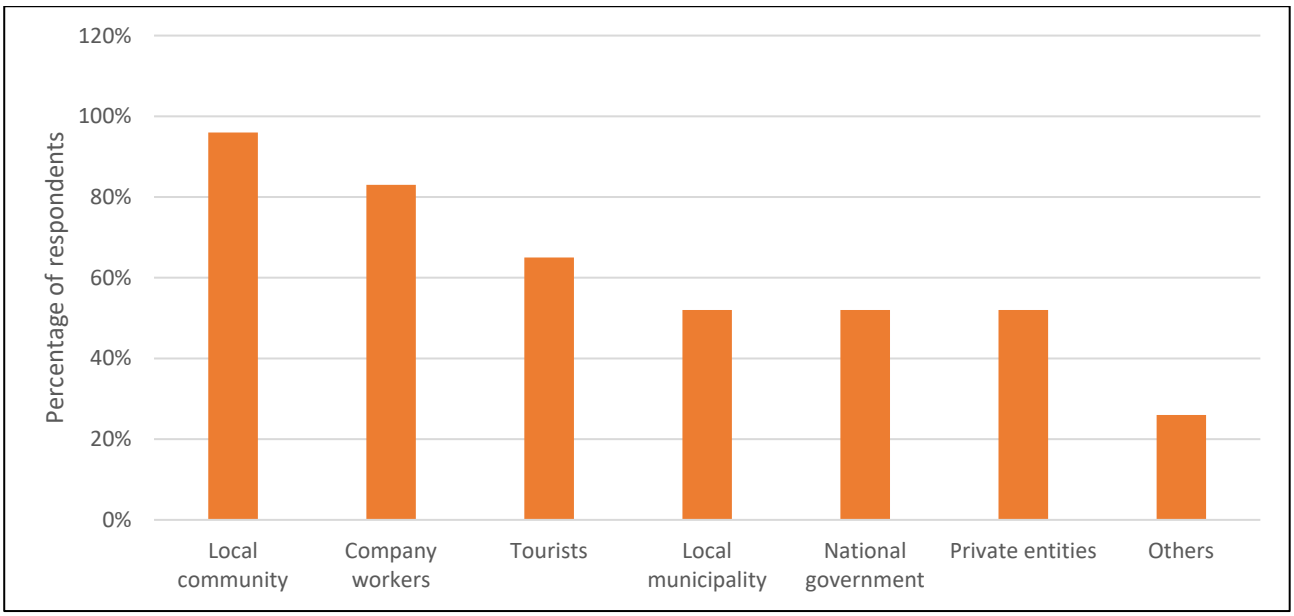

Figure 4.10: A summary of beneficiaries of ES from plantations *(n* = 23).

4.2.8 Incentive or reward for protecting and providing environmental services in plantation forests

Most respondents (83%; *n* = 24) indicated that their companies did not receive any incentive, reward or subsidy for protecting and providing ES. Half of the respondents who receive incentives received it in the form of bonuses for supplying FSC timber, and the other half received incentives indirectly though securing grants for community livelihoods and risks-management projects, which were also categorised as an indirect reward.

4.2.9 The effect of compensating for providing environmental services

Most of the respondents (83%) agreed that compensating for the provision of ES can help to conserve and restore ES. About 60% of the respondents further elaborated on the effect of compensating for the provision of ES. Approximately 40% of the respondents explained that compensating for the provision of ES will play an important role in implementing programmes and systems that focus on saving ES and will serve as motivation for responsible forest management (33%) (Figure 4.9). Some respondents (11%) indicated that compensation would help offset the costs of managing for improved ES supply.

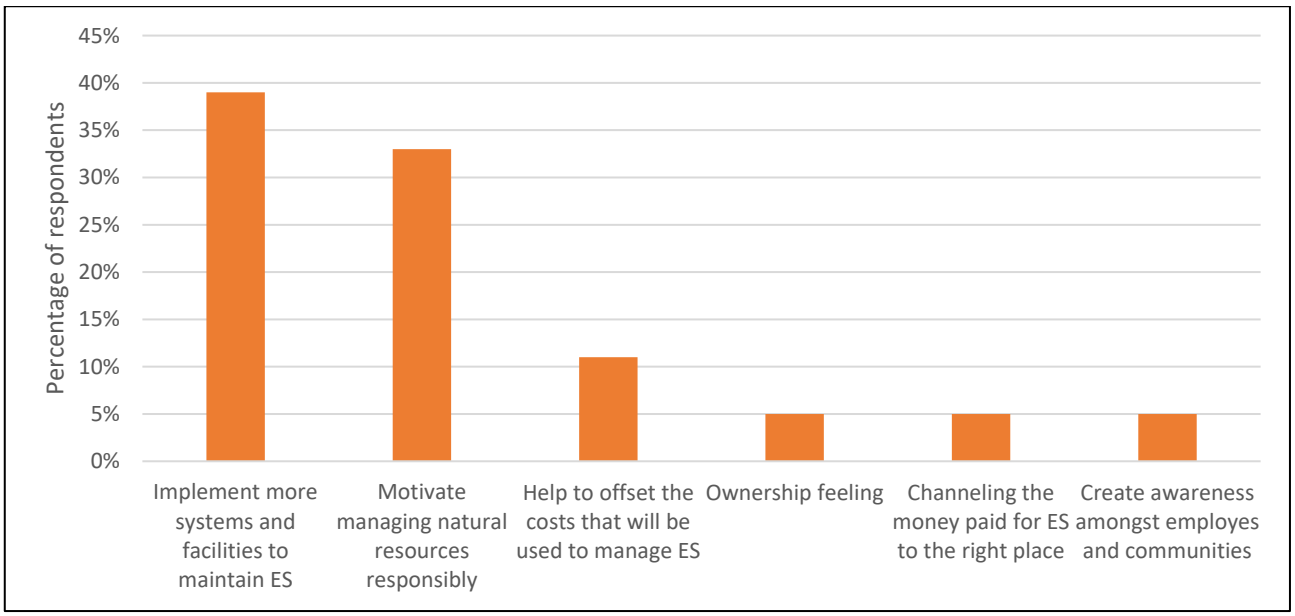

Figure 4.11: A summary of the effects of compensating for provisioning for ES (*n* = 18).

4.2.10 Environmental services projects that are found in plantation forests

The participants were asked if their companies participated in any ES projects. More than a third of the respondents (35%) stated that their companies were not involved in any ES projects (Figure 4.10). Respondents involved in ES projects included carbon offsetting (17%), FSC certification and carbon credit trading (13%), REDD+ (9%), as well as bio-energy projects such as firewood collection or charcoal making (4%). Twenty-two percent were involved in other projects.

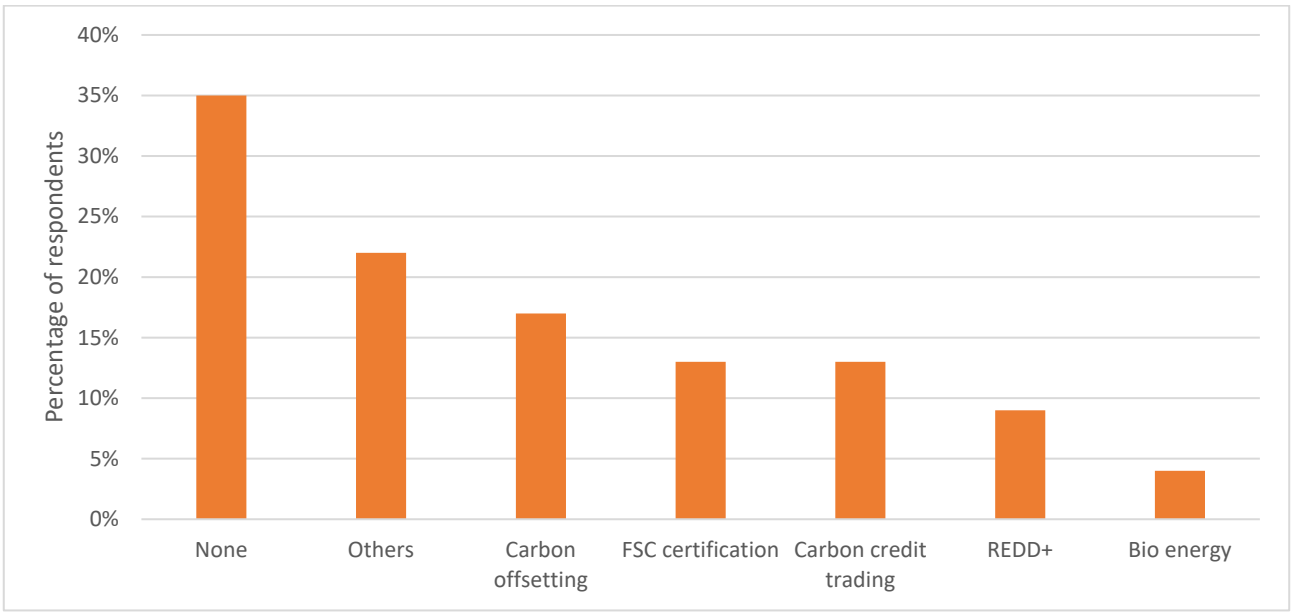

Figure 4.12: A summary of ES projects in which the respondents participated (*n* = 23).

4.2.11 The penalties for negative effects on environmental services in plantation forests

The respondents indicated that paying for water-use licenses and the loss of FSC accreditation due to poor environmental management were the two largest “penalties” for the effect of plantations on ES.

4.2.12 Suitable PES for forestry companies

Most respondents (71% of 24) indicated that tax credits would be the most appropriate payment for forestry companies; two-thirds (67%) of respondents indicated certification as the most appropriate payment; 50% of respondents selected direct financial payment; and 42% selected recognition as the most appropriate payment for forestry companies (Figure 4.11). Offsetting “penalties” was seen as a suitable reward by 21% of respondents.

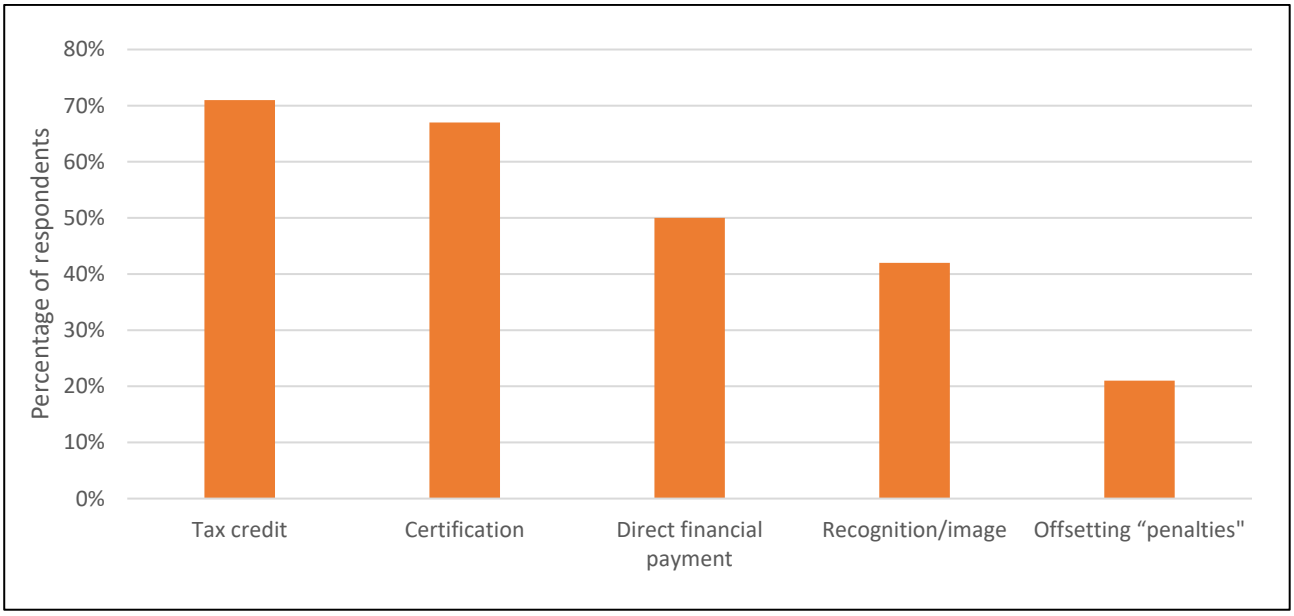

Figure 4.13: A summary of types of payments that are most appropriate for forestry companies (*n* = 24).

4.2.13 PES system that could work in plantation forests in SA

Different responses were obtained on whether a PES system could work in South African plantations. A quarter of the respondents (25%; *n* = 24) indicated that a non-monetary PES system could work in SA, while 21% indicated that a monetary system could motivate companies to save ES (Figure 4.12). Twenty-one percent of respondents felt that a PES system should be linked to certification, while 8% believed that involving the communities in PES systems could work, and 4% of respondents believed that there is a need to develop a simple way to measure ES before having a PES system. However, 17% of the respondents were not sure how to answer the question.

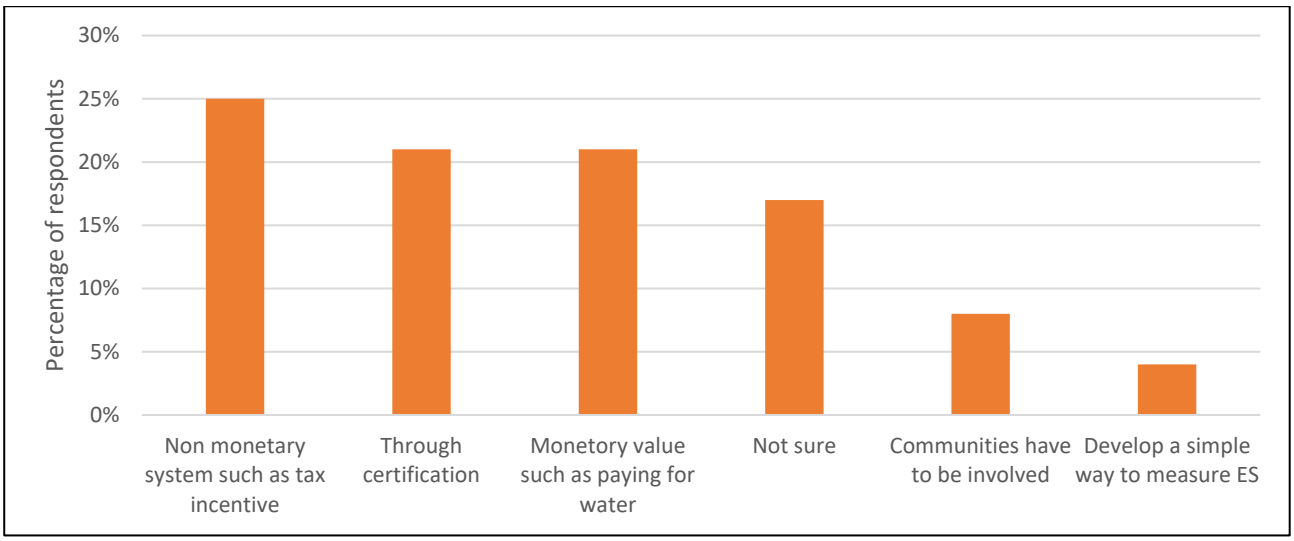

Figure 4.14: A summary of PES systems that could work in South African plantations (*n* = 24).

4.2.14 The managers of a PES system

Participants were asked to explain whom they thought should manage the proposed PES system. Only 42% of respondents (*n* = 24) thought that government should manage a PES system; 33% suggested that the companies that are managing the plantations should be managing the PES systems; and 17% of respondents thought that an independent agency (IA) should be managing a PES system. About 12% of the respondents indicated that FSA and FSC should manage a PES system, while 8% believed that an academic institution should manage the system. Another 17% of the respondents were not sure about who should manage a PES system (Figure 4.13).

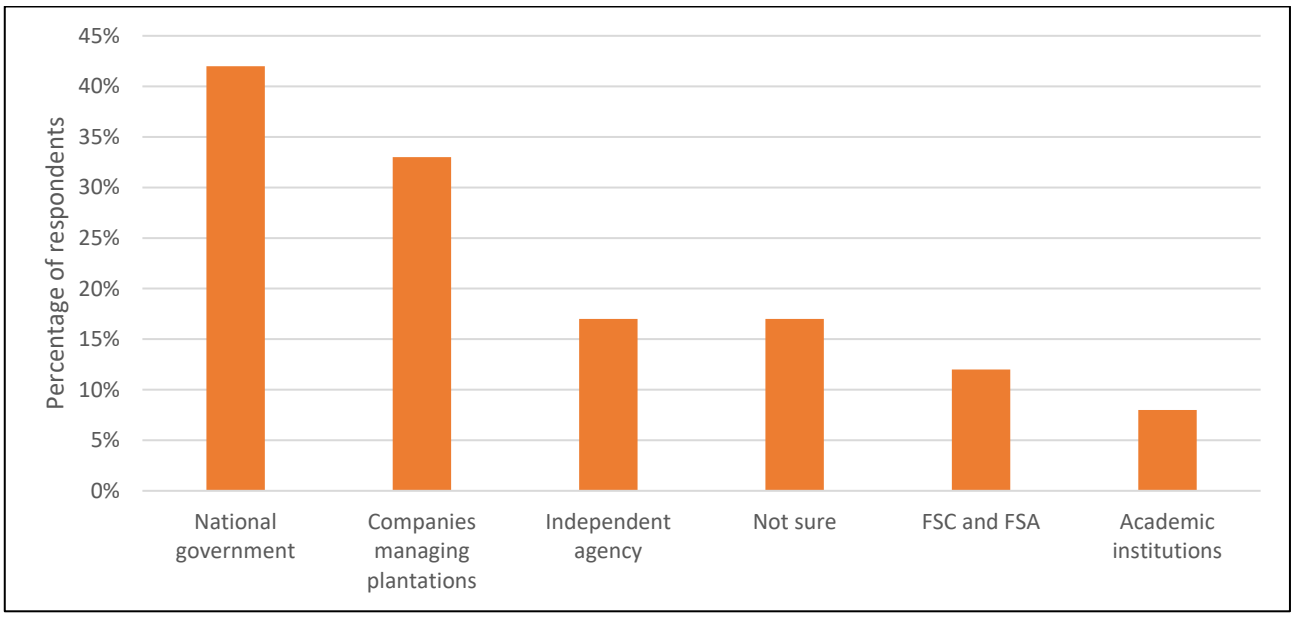

Figure 4.15: A summary of organisations that should participate in managing a PES system in SA (*n* = 24).

4.2.15 Plantation forest companies that are part of PES schemes

Only four respondents indicated that their organisations were involved in PES schemes. The first respondent specified that his/her company paid communities to reduce and respond to the risk of fire, theft, grazing and so forth. The second respondent indicated that they were part of a declared

protected environment in one plantation. The third respondent said that his/her company participated in a forestry-for-prosperity scheme, and the last respondent had a budget specifically for ES, for the sake of corporate social responsibility.

4.2.16 Examples of PES in the forestry sector

Most respondents (58% of *n* = 24) did not know of any example of PES in a forestry context. A third of the respondents listed examples such as involvement in FSC, Working on Fire and Working on Water schemes and participation in water-use licences, market access and carbon credits.

4.3 First round of Delphi study survey

The first round of the Delphi questionnaire consisted of 12 open-ended questions. Responses were summarised and are presented according to each question in the section below.

4.3.1 Relevant and suitable incentives for the plantation forests sector

The key finding was that different incentives work for different ES in plantation forests, and therefore the most appropriate incentives need to be determined for each need or service. Obtaining certification was deemed to be the most important incentive that could work effectively in plantation forests. Other useful incentives included tax credits and a carbon tax, which present an opportunity for rewarding carbon storage whereby existing plantation sites may be utilised to plant more trees and maximise carbon sequestration.

4.3.2 Introducing and implementing incentives to preserve ES in the plantation forests sector

The majority of panel members confirmed that there was a lack of a policy programme with a well-defined set of incentives. Furthermore, it was also confirmed that there was a lack of knowledge about how incentives work in the sector. There also was no simple incentive system available, but there were various command-and-control efforts as well as legislation to manage environmental services in SA. According to the panel members, the government was not prepared or able to incentivise, and the private sector was also not prepared to pay for ES.

Incentives can be implemented through a joint partnership between government and the private sector to embark on proper planning, negotiation, and development of user-friendly incentives. The need for a mechanism to explore PES systems in government planning and taxes was recognised. Although the government would want to maximise tax income, if plantation forests can show how much ES they are saving or protecting from plantations it may provide grounds for negotiation on reduced levies and taxes. Furthermore, tax incentives need to be sufficient to make it worth the effort, as well as easy to verify and apply for.

4.3.3 The best workable structure for a compensation scheme

Panel members indicated that a good compensation scheme should be structured to have elements such as a compensation fund, legal framework, certification, inspection and auditing, and offset mechanisms. It was shown that, although compensation and offset schemes can work, these will require both inspectors and auditors to evaluate whether the company in question complies with all the requirements. According to the panel members, the introduction of offset mechanisms, whereby sacrificial land-use changes are ‘taxed’, can be channelled towards conservation or remedial activities that generate ES flows. However, it should be a legal obligation that is incorporated into

forest and environmental policies and acts, and needs to be done through certification in which regulations must be met to be certified.

4.3.4 PES scheme to focus on compensation or include penalties for ES mismanagement

Panel members indicated that PES should only focus on compensation and leave out penalties, as these can be dealt with through existing legislation. Plantation forest companies must be legally compliant as a minimum, and then a PES should reward them for doing more than what the law requires. PES was described as part of the market-based instruments that are used for elevating positive effects or by-products that benefit society, as a positive PES system will encourage use. On the other hand, there are PES what the industry itself can institute that could result in a monetary benefit vis-à-vis tourism, hunting, etc. Furthermore, PES should be one of the corporate social expectations that would ensure that companies are using best management practices and adhering to the laws set by the compensation scheme.

4.3.5 Relevant ES that could play an important role in PES schemes

Relevant ES recommended by panel members include water regulation, flood reduction services, recreational activities and renewable energy resources in particular. Water regulations emerged as an important ES to be added to a PES system. According to the panel members, if a plantation is seen at the watershed management level to help regulate water, then the opportunity cost could be considered and monetised accordingly.

4.3.6 The benefits of providing ES for forestry companies in SA

The panel members indicated that benefits are immense and vary from better value and management systems, stakeholder satisfaction, supportive communities and a better reputation to enhanced compliance. A key benefit is a social licence to operate. If forestry is perceived to generate more benefits than costs to the local society, they will be able to continue to function within society. For example, if the job benefits and PES gains exceed the disservices such as water losses and fire risk, then society tolerates the costs generated by forestry. It was indicated that any number of aspects under land tax could be built through material support and tax incentives, for example tax incentives for carbon credits (under the new Carbon Tax Act). However, it was stressed that a vitally important requirement for the success of a PES system would be the management of the bureaucratic burden associated with participation.

4.3.7 Local community, society, government, company worker and tourist benefits from PES in SA

The benefits of PES for communities, society, government, workers and tourists include water provision, flood control, good catchment management, better air quality, ascetics, job creation, ecotourism and mitigation against climate change. Additionally, the government would contribute to the Sustainable Development Goals (SDGs) and possibly also to the Nationally Determined Contributions (NDCs) concerning the mitigation of climate change impacts. To manage forest plantations costs money, therefore the beneficiaries should contribute towards the costs of managing forests, which will give rise to co-ownership of it in various aspects. The benefits are regarded as indirect benefits, and compensating companies will motivate them to manage their plantations in a manner that will enhance ES.

4.3.8 The best way to improve the current management culture in the plantation sector

All panel members agreed with the observation that good management is key to addressing challenges in the supply of ES. The management culture can be improved by benchmarking best practices, better monitoring, effective and user-friendly incentive schemes, and better human resource performance management. According to the panel members, good management is directed by industry best practices and legal standards. With beneficiaries making contributions to the cost of management, it will also be a recognition that the social responsibility for the forests extends beyond the forest gate. It was also indicated that FSC certification needs to be more thorough and that regulations should be enforced. The panel members indicated that larger companies will practise good management in any case due to their FSC certification. However, it is the smaller and non-certified companies that need to be improved and, in order for them to change, incentives must be real and easy enough to make it attractive for companies to adopt better management practices.

4.3.9 Key issues that can affect the implementation of a PES system in SA

Key issues affecting the implementation of a PES system in SA include lack of political will, corruption, a lack of enforcement, accountability, public awareness and efficient certification processes, a lack of clear incentives, and a lack of funding, institutional and human resource capacities. The lack of enforcement emerged as a key issue that can affect the implementation of a PES system in SA. Other key issues were government intervention, availability of a practical and cheap method of determining the services supplied, and the collection of monies from users globally.

4.3.10 Most suitable stakeholders to administer a PES scheme in South African plantations

There are different views about who is best placed to administer PES in SA. Opinions vary from an independent agency to government, with concerns about capacity and political will, and an industry body. According to panel members, an independent agency or government will be the best suited to administer a PES scheme. The government can be suitable if it also provides the necessary skills and human resources to design, implement, and maintain systems. The point of debate was that a government-led PES system was not viable in SA given the lack of capacity within government. Besides, the allocation of rights to ES does not exist in the SA legal system, making trading for benefits difficult.

4.3.11 Rewards and penalties that can be implemented to preserve water in plantation forests

Tax incentives and the improvement of water-use licencing were identified to be the best rewards for preserving water. Enforcement to control alien vegetation, water resource management, and catchment management were identified as penalties to preserve water in plantation forests. Tax incentives emerged as the best reward for preserving water and the control of alien plants in plantation forests. According to the panel members, forest management at the watershed management level can be seen to improve water supply, and then the rewarding scheme possibly could be devised as a function of the volumes of water contributed. It was mentioned that PES should not include penalties, but should focus only on the beneficiaries and the marginal value they receive from the water over and above streamflow. Also, water quality is currently poorly valued in SA and is a significant ES derived from plantation forestry. Furthermore, it was not agreed that forestry supplies water. This observation correlates with the key informant survey, in which it was mentioned that plantations could lead to a 25% reduction in water supply.

4.3.12 Comments on CF

Panel members were asked to comment on the structure of the draft CF. This is discussed in section 4.7.

4.4 Second round of Delphi study survey

The second round of the Delphi study questionnaire consisted of six open-ended questions. Responses were summarised and are presented according to each question in the section below.

4.4.1 Certification as the best way to improve ES in plantation forests

Three of the five panel members agreed that certification plays a key role in improving ES. A panel member pointed out that certification can only improve ES if the certification is done by a credible body. The challenge with certification is that it may prove expensive for smallholder or growers, and therefore needs to be improved to be more accessible. Those who disagreed believed that FSC is a voluntary system undertaken by companies, normally due to the demands of shareholders or for legal or lease requirements. The argument is that it should not be seen as a benefit when it comes to PES. The provision of PES is largely seen as an offshoot of good management, and FSC certification is not always deemed to be a reward as such. The only way it could be a reward is if it provides extra benefits to a company.

The panel members suggested bringing smaller companies that cannot afford certification into the PES framework. This included the adoption of a landscape-level approach to certification, whereby natural systems across various types of land use at a regional or larger-scale level are protected or restored. Cost of certification can then be shared at a landscape level, with larger companies supporting small companies. The second approach was for smaller companies to form co-operatives or joint efforts through the syndication of benefits. According to the panel member, this would be a group scheme by small players through a jointly owned enterprise that shares common economic, social and cultural needs, as well as similar aspirations. The last approach was to ensure that there were honest brokers or trustworthy institutions that were able to bank or collect small amounts from smaller companies to the point where economies of scale could operate.

4.4.2 The focus of a national policy programme on PES

The panel members suggested having a policy that focuses mainly on water as the most important resource issue in SA, given that it is a water-scarce country. A second suggestion was to have a policy on maximising water benefits (water quality and quantity). However, it was advised not to cover every service and aspect, which would complicate a national framework, and rather to establish it as a prioritisation strategy for water resources. The second advice was to develop a national policy that focuses on incentivising landowners to manage resources to provide ES, and also the enforcement of environmental regulations. It was suggested that a strong transaction mechanism should be developed that will clearly show the process between the buyers and the sellers in order to reduce the risks for all parties. This would help in coming up with a clear payment modality.

4.4.3 Capturing the complexities of a PES in an effective system

The best way to capture the complexities of a PES in an effective system is by identifying key management activities that enhance ES. One of the key management activities can be annual auditable return on performance against activities, with rebates or incentives based on returns. The

complexities of a PES can be captured in an effective way by auditing sample of returns, with penalties for inaccurate returns. It was advised by other panel members to develop an easily understood payment system by linking the payment system to a system paying for activities and well-defined output indicators. The advice was also to start around water by having a dialogue to decide how to work together in test-case priority catchments. It was also advised to measure the performance of the company and to provide tax incentives only for the companies that are managing their plantation forests well and doing more than what is required. The survey results indicated that the government has a streamflow reduction tax for forestry as it reduces stream flows. If forestry was to increase flows, then it could be given streamflow reduction tax credits to the point where it becomes water neutral and pays no tax.

4.4.4 Using the PES system to change behaviour in plantation forests

To change behaviour in plantation forests, it was recommended to train and incentivise or compensate prudent management. Panel members further provided different views and ideas, such as using a combination of rewards and punishment to induce a desired behaviour approach. The panel members believed that only if rewards amounted to genuine benefits and the amount of work that it takes to implement, must be much less than the benefits it will bring. It was suggested that the PES system should help a company in tangible ways and not in theoretical respects. According to the panel members, export markets should also have audit processes. Another idea was that there should be independent auditing methods to audit the state of an ecosystem to give clarity on the ES provided and management effectiveness. It was also indicated that PES only works when the services or a desired state of ecosystem is supplied (e.g. an alien-free riverbank, cleared 10 metres on each side).

4.4.5 Thoughts and ideas about PES in SA

The panel members largely shared the same thoughts on the main issues that may affect the PES system in SA. This is the institutional capacity to implement and administer a PES system. It was mentioned that there are many issues regarding who is able to administer PES, such as the private sector not taking the lead currently, which might change soon. According to the panel members, the public sector cannot take the lead because it cannot really engage in financial transactions. The capacity of government to implement a PES system effectively and in an audited, accountable fashion is lacking. However, the suggestion was to focus on enforcement of the current regulations, since it would be difficult to comply with all environmental legislation for improving the provision of ES. It was mentioned that a PES system is being addressed without intention by forestry companies, but rather is driven by the international markets for certified timber. It was advised that the forest industry should focus on a system to provide streamflow enhancement gains that will enable it to reduce the burden of reducing stream flow.

4.4.6 Comments on CF

Panel members were asked to comment on the structure of the draft CF. This is discussed in section 4.7.

4.5 Third round of Delphi study survey

In the last round of the Delphi study survey, the experts were informed about the results from the second round and were asked to review their opinions in the light of the average results. The

questionnaire included three questions to reach common agreement between the panel members and clarity on recommendations.

4.5.1 Recommendations on certification design and implementation to improve PES in SA

All the panel members agreed with the recommendation that certification should be designed and implemented in such a way that it can be used by both large and small companies to improve PES in SA. Grouping the ES providers that cannot afford certification can be a good way to make certification possible. Hence, the certification system can be designed to cater for all scales of forestry, provided they are relevant to scale and affordable. The panel members believed that this would work especially well for small growers and would absorb the cost for individual smallholders. Certification would also be an excellent tool to improve PES, provided that the mechanisms to make it easier for small growers to join continue to be developed.

4.5.2 Recommendation to develop a national policy programme

All the panel members agreed on and supported the recommendation to develop a national programme with specific key elements. However, it was advised not to develop a new ES policy but rather to adapt existing policies related to the environment, water and forestry. The approach used by FSC of having a separate procedure to certify ES was not supported due to the additional costs that come with it. It was suggested that policies should concentrate on smaller growers or landowners, non-FSC-certified forest owners and streamflow-reduction interventions. Policy adjustments should focus on an incentive system, like a stream-flow enhancement policy, so that forestry can become water neutral. A certification standard should be developed that is robust enough to guarantee that good management practices are implemented, and environmental services are provided as a result.

4.5.3 Recommendation on a systems approach to manage the complexities of a PES

All the panel members agreed that a systems approach was the best way to manage the complexity of PES. Payment for environmental services needs a simple system of suppliers and buyers. The system needs to be easy to implement, to audit and to monitor the results. When the system is simple, it will be easier to implement and will reach a larger group of landowners and managers. This will also assist in making sure that the benefits are real and exist on the ground, and that the benefits and the process are auditable.

4.6 Summary of Delphi study survey

A good compensation scheme should have elements such as a compensation fund, legal framework, certification, inspection and auditing, and offset mechanisms. However, certification emerged as the best system for the backbone of a PES scheme. It was agreed by all the panel members that certification can be designed and implemented in such a way that it can be used by both large and small companies to improve PES in SA. Therefore, a PES system should be based on certification at the landscape level to also accommodate small-scale growers. According to the panel members, certification will also be an excellent tool to improve PES, provided the mechanisms to make it easier for small growers to join continue to be developed.

Good management was indicated as key to addressing challenges in the supply of ES. An independent body or industry association was suggested for managing a PES system together with government. However, the government lacks capacity to manage a PES system. According to the

panel members, the government would only be suitable if it also provided the necessary skills and human resources to design, implement and maintain the system. An independent body such as a catchment management agency could be tasked with the responsibility for water-use licencing and water allocations in catchments. The agency can also play a role by being a key stakeholder in PES schemes with water as a central focus in the plantation forests.

It was agreed and supported by all the panel members that a national programme should be developed with specific key elements. However, the system to be developed should be accommodated within existing legislation and policies, such as environmental, water and forest policy. It was suggested that policy changes should concentrate on smaller growers or landowners who are non-FSC certified and on streamflow reduction. The advice was also to include an incentive system like a stream-flow enhancement policy so that forestry can become water neutral. The panel members suggested that water should be the main ES to focus on when developing a policy due to water being scarce in SA. According to the panel members, there should be rewards for preserving water, and improving water-use licencing was identified as the best and most suitable reward.

The panel members advised that PES should focus only on incentives and not penalties, as penalties can be dealt with through existing legislation. However, the incentives to be introduced need to be a genuine benefit, and the amount of work that it takes to implement them should be much less than the benefits they will bring. According to the panel members, the PES system to be developed should help a company in tangible ways and not in theoretical aspects.

4.7 Development of conceptual framework

4.7.1 Generic conceptual framework developed from literature

A generic conceptual framework (CF) for the management of and payment for ES was developed based on a literature study (summarised in Chapter 2) (Figure 4.14). This covered elements of providers and beneficiaries of services, types of services and the links between services, providers and users, the processes to be followed in order to improve ES in the plantation forests through PES rewards, PES administration, PES penalties and ES operational guideline. ES from plantation forests that provide direct and indirect benefits to human society were identified based on the literature review. According to Blignaut *et al*. (2008), water, carbon storage and carbon sequestration, biodiversity and landscape beauty are the more marketable ES in plantation forests.

Climate regulation was the first to be considered in the CF due to plantation forests having high carbon storage compared to many native forests (De Groot & Van der Meer, 2010). Carbon sequestration is the ES linked to climate-regulation functions that provide clean air to human beings. Raw materials such as timber and fibre from plantations were also added to the CF. The benefits linked to raw materials were energy provision (firewood), corporate social investment, job creation and funds for small growers. According to De Groot *et al*. (2002), nutrient cycling is mostly linked to the maintenance of healthy and productive soils that also play a role in the regulation of gas, climate and water functions. Air quality regulation provides similar benefits to nutrient cycling, such as providing clean air by capturing dust particles and CO_2.

The recreational use of plantations and the associated cash payments were added to the CF. Water regulation linked to the interaction between plantations and water supply, as well as its influence on water quality, was included in the CF. Aesthetics was the last ecosystems function added to the CF, as it plays a role in tourism and recreation.

Local communities, society, local workers and tourists were added as the beneficiaries of ES in plantation forests. Local communities benefit from ES in the plantation in terms of clean air provided by trees and also firewood. Workers also benefit by obtaining jobs in plantations, and tourists benefit

from recreational activities in plantations. Forestry companies, farmers, industry and national government were added in the CF as providers of ES.

Throughout the literature review (Chapter 2), it was identified that poor management in plantation forests causes a large negative effect on ES. Therefore, good management of ES in plantations was added to the CF to improve the supply of ES. For good management to take place in plantations, the need for administrators was highlighted. It was identified during the literature review that poor administrative selection is one of the issues that can influence the effectiveness of PES. Therefore, it was important to include PES administration in CF and put forward some suggestions based on the literature.

According to Milder *et al*. (2010), PES is used as an approach to manage ES using rewards to motivate environmental conservation and restoration. Recognition, bioenergy, carbon credit trading and tax credits were included in the CF based on being the rewards mentioned most in other countries. Examples of such rewards were elaborated on in Chapter 2. Most of the PES schemes focus more on carbon sequestration and the protection of existing carbon stocks, biodiversity conservation and landscape restoration, as well as on watershed protection and rehabilitation (Swallow & Meinzen, 2009). Therefore, from the examples identified, recognition, bio-energy and carbon credit trading, tax credits and REDD+ were added to the CF.

Penalties are being applied all over the world to companies that damage ES in plantation forests. Therefore, water-use licence payment, land degradation, plantation establishment and loss of FSC accreditation were PES penalties included in the CF. The penalties were also added to allow the key informant survey respondents to select the suitable penalties for plantation forests in SA. The ES operational guideline in the CF includes monitoring of ES, awareness creation, educating workers and communities about ES, and the implementation of better management in plantation forests. These were added to the CF to guide PES rewards and penalties and for a PES administrator to use the guideline in managing ES in plantation forests.

The framework in Figure 4.14 illustrates the linkages between ES in plantations, beneficiaries and providers of ES, and an outline for a possible system to manage a PES in South Africa.

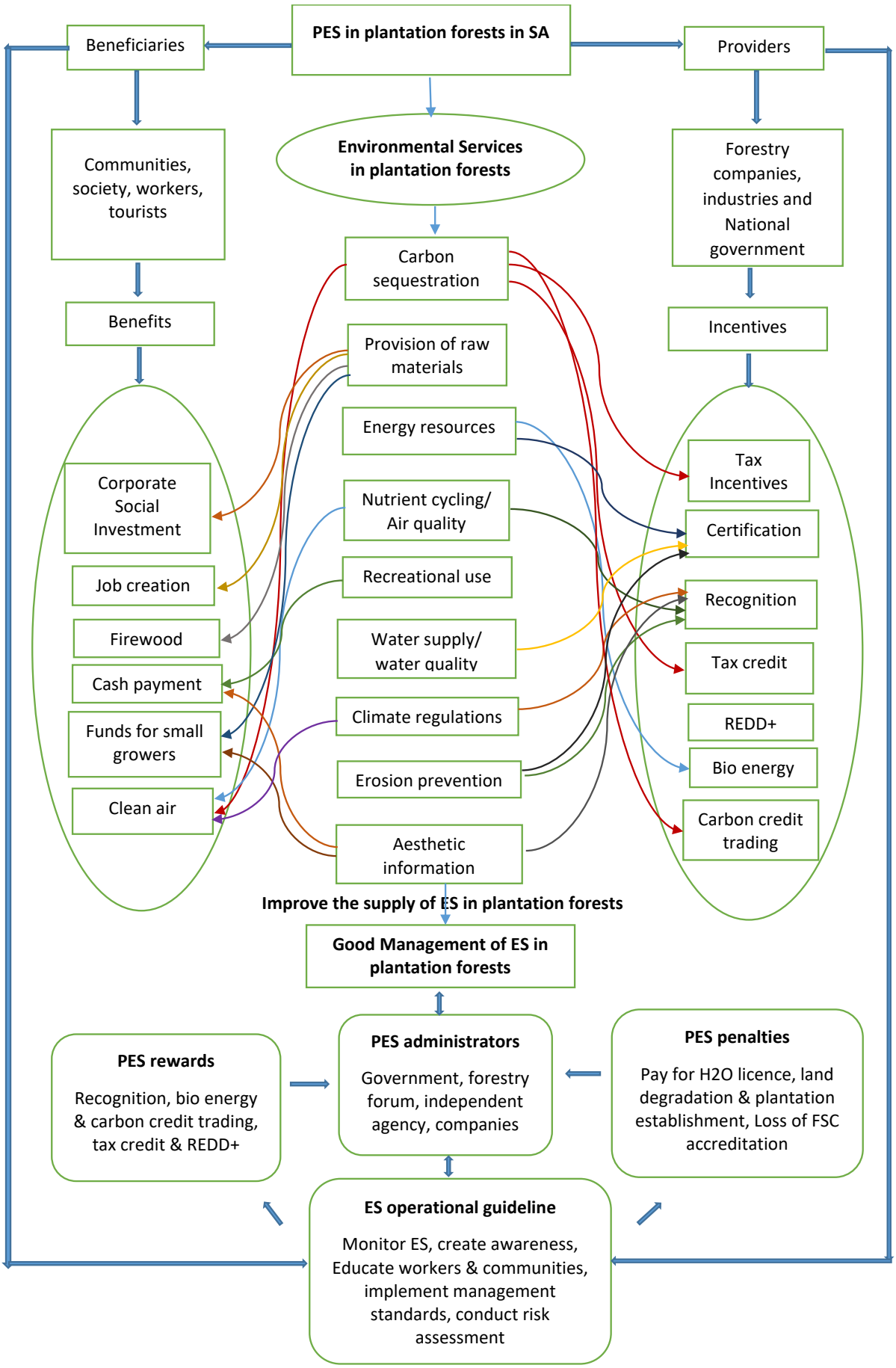

Figure 4.16: Generic PES conceptual framework based on literature.

4.7.2 Conceptual framework updated after key informant survey

During the key informant survey, participants were asked to comment on the draft generic conceptual framework. According to the respondents, carbon sequestration, provisioning of raw materials, energy resources, nutrient cycling, air quality, climate regulations, erosion prevention and aesthetic preservation were the most important environmental services found in plantation forests in SA. The respondents also indicated that, while forestry companies were the providers of ES, local communities, national government, society, company workers and tourists were the beneficiaries of such ES. Water use was identified by the respondents as one of the biggest issues in plantation forests. Plantation forests play a role in the depletion of water resources, but could also play a positive role in catchment management. Penalties for damaging ES in plantations, such as land degradation, could be included in the PES system, while increases in ES, such as increased carbon sequestration from plantations, could be rewarded.

Based on the survey, compensation for the provisioning of ES can motivate the forest industry to restore and conserve ES. This can be done by introducing non-monetary incentives suitable for forestry companies, such as recognition, tax credits, bio-energy and carbon credit trading. According to the survey respondents, a South African PES system could be managed by various role players, including government, a forestry forum, forestry companies or an independent agency. An administrator would have to set guidelines, but also manage a reward or penalty system. Tasks need to include monitoring of ES, awareness creation, education of workers and communities, implementation of management standards and risk assessment.

This information was used to update the CF (Figures 4.15 and 4.16). The survey responses assisted in simplifying the CF and highlighting clear paths between services, beneficiaries and providers. Based on the responses, the CF diagram was split into two sections – A and B. Section A deals with the interactions between ES, beneficiaries and providers (Figure 4.15), while section B illustrates a possible command and control system for a PES (Figure 4.16).

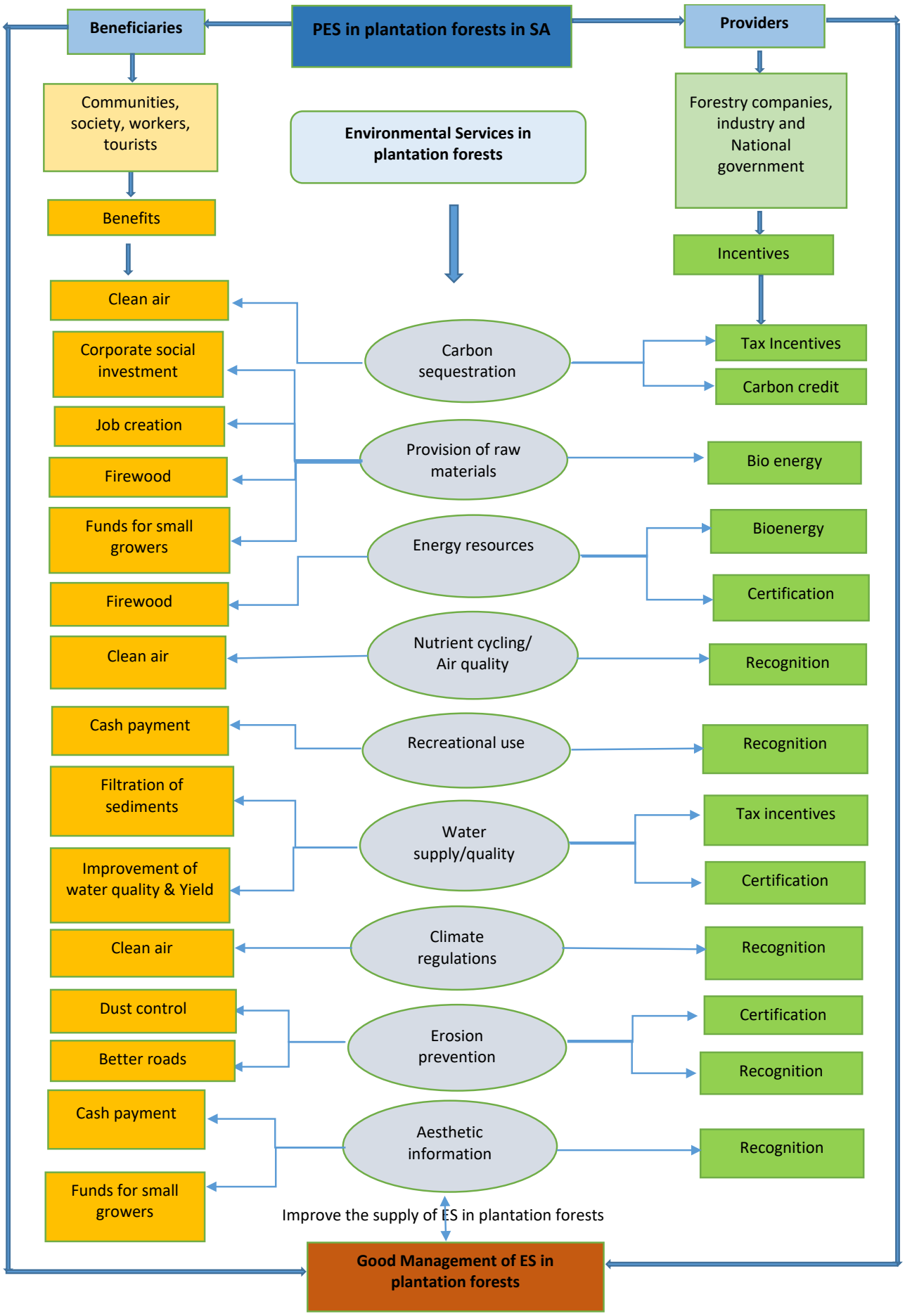

Figure 4.17: Relationship between ES, providers and beneficiaries deduced from key informant survey.

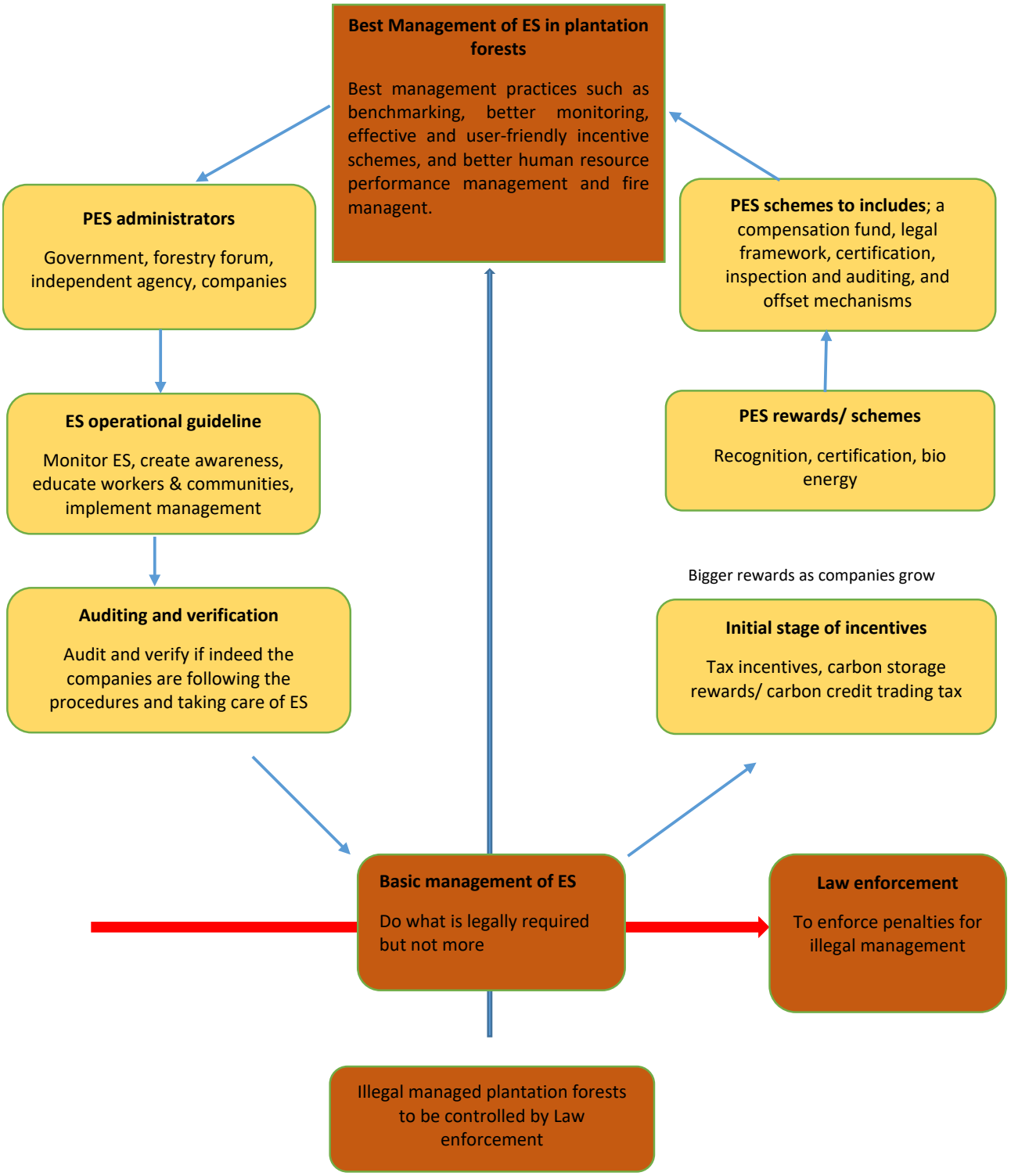

Figure 4.16: PES management system based on information from key informant survey.

4.7.3 CF updated after conducting Delphi study

The panel members were satisfied with the updated CF developed after the key informant survey. According to their comments, the CF was clear and easy to understand. Some suggestions made from the first round of the Delphi survey to the third round were incorporated into the CF (Figure 4.17

and Figure 4.18). According to the panel members, water resources were the most important ES to be considered in plantation forests due to water being scarce in SA. Therefore, water resources were the first ES to be added to section A of the CF (Figure 4.17). The panel members advised that the focus should be only on water resources. Therefore, water resources were added in the CF management part in section B (Figure 4.18).

Rewards for water preservation were included in section B (Figure 4.18). These rewards were tax incentives, stream-flow reduction tax for forestry, and improvement of water-use licencing. It was suggested that, although enforcement and penalties should not be included in the PES, water resource enforcement should be included in order to find a way to maximise water quality and quantity in plantation forests. Therefore, plantations should be forced to control alien vegetation, implement water resource management, enforce delineation requirements to preserve water, and implement water-use licences and control of catchment management in their plantation forests. A guideline to maximise water in the plantation was also added to the CF. According to the survey, water in the plantation forests can be maximised by ensuring that stream areas and rivers are delineated. The clearing of invasive alien plants from mountain catchments and riparian zones can also play a role in maximising water.

According to the panel members, in order for a PES system to be managed well in the plantation forests there should be good PES administrators to address challenges in the supply of ES. Therefore, an independent body or forum was added as the best PES administrator. According to the panel members, a compensation scheme should be easy to implement and audit to monitor the results. The PES compensation structure in section B includes compensation funds, a legal framework, certification, an offset mechanism, inspection, auditing and verifying to indicate whether the companies are following the procedures and taking care of ES.

The rewards suitable for bigger and smaller companies are included in section B. According to the panel members, certification was identified as the best system for plantation forests, especially for small growers. It was agreed by all the panel members that certification could be designed and implemented in such a way that it could be used by both large and small companies to improve PES in SA. In section B, the PES system is based on certification at the landscape level to also accommodate small-scale growers. Benchmarking best practice, better monitoring, effective and user-friendly incentives, better HR performance management, best practices and legal standards were identified as the best ways to manage plantation forests. All these management practices were included in the CF. Plantation forest companies must be legally compliant as a minimum, and then a PES should reward them for doing more than what the law requires. The CF will not control the mismanagement of ES or illegal management; these will be handled by law enforcement, except in relation to water resources. The reason for not excluding water resources from being enforced is based on water being scarce in SA and therefore needing more attention.

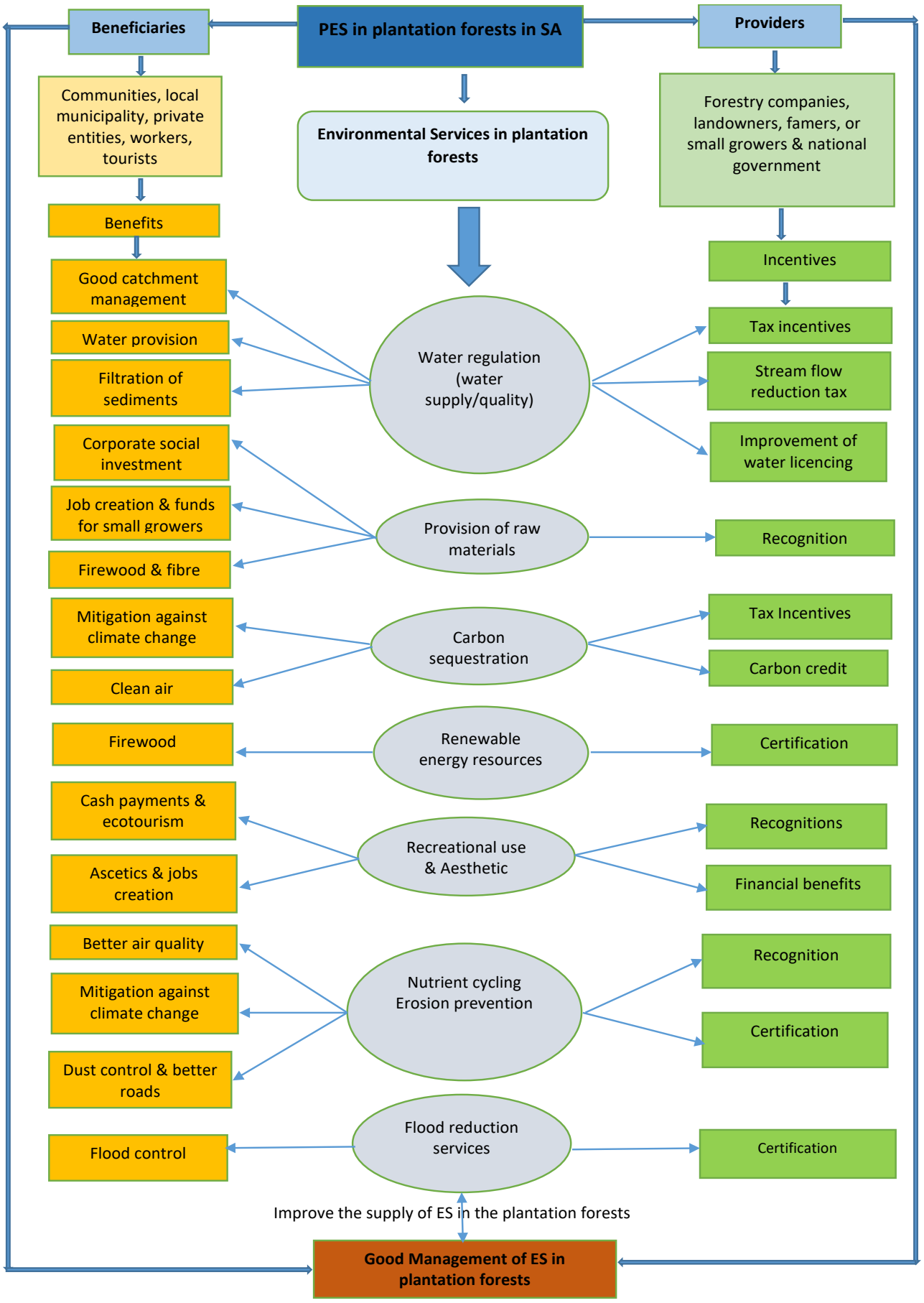

Figure 4.17: Relationship between ES, beneficiaries and providers deduced from Delphi study.

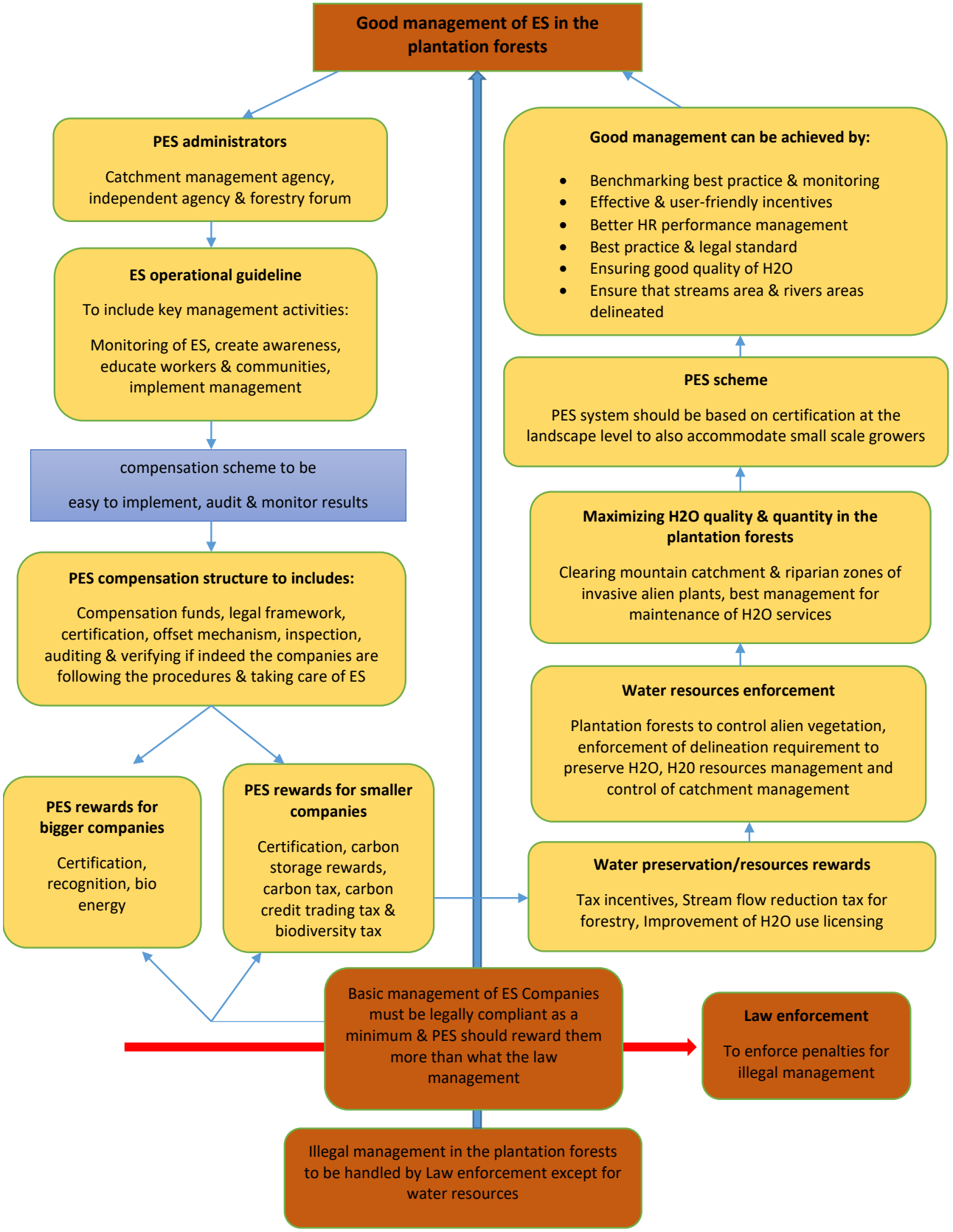

Figure 4.18: Management of a PES scheme based on Delphi study results.

Chapter 5: Discussion of conceptual framework

5.1 Introduction

The plantation forestry sector, with its 1.27 million ha of plantations (South African Government, 2020), is a relatively large sector with a big environmental footprint. The purpose of this research was to investigate and define the concepts related to PES schemes. The outcomes of this study and the conceptual framework can be used to assist forestry companies in SA to protect and conserve ES through well-developed PES schemes. Plantation forests play a role in protecting ES, but they can also affect ES negatively. However, if there is proper planning and management in plantation forests, they can potentially help to preserve ES. This can be done through land-use management that provides a well-organised source of renewable raw materials to mitigate climate change (NGP, 2015). A properly functioning PES can be used to manage ES through cash payments or other forms of compensation or rewards to motivate environmental conservation and restoration (Milder *et al*., 2010). The study aimed to design and introduce a conceptual framework for a PES system that could help to stimulate debate around this topic and suggest solutions for the industry. The key elements of the CF are discussed in this chapter to illustrate how it will function to preserve ES in the plantation forest industry.

5.2 Effect of plantations on environmental services

As much as commercial plantations supply and play a role in protecting and conserving ES, they also cause damage such as a loss of biodiversity and aesthetic value associated with landscape-scale conversion from natural ES to plantation forests (Kanowski, 2010; Kubiszewski *et al*., 2017). They come with an environmental cost and negative effect on the environment. According to Geldenhuys (1997), there is a need to balance these negative and positive aspects of commercial forestry plantations. The negative effects can potentially be balanced by an effective PES (Shackleton et al., 2007; Sherbut, 2011). According to Wunder (2008), PES is an attractive conservation tool used to preserve and restore ES, whereby the user of ES pays the provider to supply the services. Around the world, many forestry owners and companies are committed to improving their environmental performance and restore important ES through PES (NGP, 2015). PES is already employed in SA through the Working for Water programme to promote sustainable land use and improved management of scarce water resources (Sherbut, 2012). The remainder of this chapter will discuss the CF developed in this study.

5.3 Final conceptual framework developed in this study

The final CF developed consists of two diagrams: Section A focuses on the interaction between stakeholders and ES in plantation forests in SA, and section B focuses on the management of a PES system (Figure 4-17 and Figure 4-18). These are discussed below.

5.3.1 PES in plantation forests in SA (Section A)

5.3.1.1 ES in plantation forests and their link to the benefits they provide and incentives

According to Bauhus and Schmerbeck (2010), plantation forests provide timber, charcoal, pulp, carbon sequestration, biodiversity, erosion control and water regulation. These services and others were captured in the CF (see Figure 4.17). Water resources management was identified as the most important ES in plantation forests in SA. Species such as eucalypt use more water compared to other species found in natural forests. According to Maginnis and Pollard (2006), eucalypt account for as much as 25% of plantation area worldwide. Although there are negative effects caused by the plantations on water supply and quality, plantation forests also filter rainwater and runoff water and regulate water by buffering extremes in runoff and river discharge, which are positive effects. The benefits of water regulations included in the CF are good catchment management, water provision and filtration of sediments. Good catchment management plays a role in reducing soil erosion and surface run-off (Kanowski, 2010). Plantations with good land cover can also play a large role in regulating water flow and ensuring high water quality under any hydrological and ecological conditions. People also benefit from water provision when it is available for drinking, irrigation and industrial use (De Groot *et al*., 2002, Blignaut *et al*., 2008). Therefore, it is important to include water as a critical resource in the CF, since water plays a big role in the success and sustainability of plantation forests in SA. The CF included rewards to compensate those who play a role in preserving water in plantation forests. Although penalties for mismanaging ES were excluded in the CF, it was important to include water usage enforcement, since plantations account for 3% of water usage in the country (FSA, 2019).

The incentives suitable for water regulation services that were identified and chosen for this CF are tax incentives, such as streamflow reduction tax and the improvement of water-use licencing. The challenge with these tax incentives is that water is a public good and communities are not willing to pay extra fees, which do not always work. Other new incentives include a Greater Cape Town Water Fund with the aim of bringing together private- and public-sector stakeholders alongside local communities around the common goal of restoring surface water catchments and aquifers that supply water to the city (SANBI, 2019). According to Mayrand and Paquin (2004), watershed-based services are frequently subsidised through user fees in order to finance improved management of the protected area upstream. Therefore, tax incentives and streamflow reduction could be used as incentives whereby the providers will be subsidised for protecting water, and this will assist providers to improve the management of their plantation forests.

According to De Groot and Van der Meer (2010), plantation forests are an economic business with the purpose to provide raw materials such as timber, fibre, etc. Due to environmental concerns, plantations are required to minimise negative effects on the environment and play a larger role in saving ES. The survey findings indicate that the provision of raw materials benefits communities around the plantation, workers and local municipalities by providing formal and informal jobs in the forestry value chain. Local communities also benefit by obtaining firewood from plantation forests, as discussed in Chapter 2.

Job creation and a supply of raw material to local stakeholders is often part of the corporate social responsibility programmes of forestry companies. Sappi, for example, is committed to training smallholders in more sustainable forestry practices. The company has successful water-usage management, with targets, and has funded the rehabilitation of water infrastructure in villages close to the areas of their operations (Sappi, 2019). Companies such as Mondi and SAFCOL have implemented social and environmental practices in their plantation forests. SAFCOL facilitates

accredited training to empower local communities and employees in terms of sustainable fibre sourcing and forest management (SAFCOL, 2017).

The Mondi Group (2019) is committed in making sure the communities around its plantations are safe by minimising and eliminating potential negative effects on these communities and the environment before any harm can occur. When a negative effect is identified, the company also implements appropriate measures to reduce it. These forestry companies try to minimise their negative effects on the environment and provide materials and services to local stakeholders as a way of creating a good reputation and being recognised as companies that play a role in improving the environment. Mondi, for example, makes sure it does not source wood or fibre from regions that are at high risk of deforestation in order to protect ES in that area (Mondi Group, 2019). It also takes action to manage the effects on the environment by reducing the carbon footprint of its products and refining its approach to source sustainable fibre and forest products. Although companies like Mondi are involved primarily in the packaging and paper business, they are committed in making sure that forests are protected and managed sustainably (Mondi Group, 2019).

Carbon sequestration was added to the CF because of its role in plantation forests. According to Mayrand and Paquin (2004), forest planted trees absorb CO_2 in the atmosphere and store it in biomass, resulting in mitigating against climate changes and providing clean air to the local environment, tourists and the government. Based on the survey findings, tax incentives and carbon credits can be provided to small growers and farmers to plant trees and commit themselves to not cutting trees around their communities. This will be similar to the PES scheme examples from Uganda and Costa Rica discussed in Chapter 2. In SA, plantation forests could receive incentives such as tax reductions and carbon credits. Such incentives can be suitable for mitigating against climate change, as plantation forests can preserve or protect forest areas with a high stock of forest carbon.

Plantations can also play a role in providing renewable energy resources, whereby local communities can benefit from the supply of firewood. Most of the people staying next to plantations still use firewood for cooking, etc. De Groot *et al*. (2002) confirmed that plantations supply energy resources such as wood for fuel. Bioenergy is an incentive used by plantation forest managers. This can work very well for smaller growers, since most of the small growers cannot afford certification. Therefore, receiving bioenergy materials such as wood for providing and protecting ES can be good incentives to motivate them.

Plantation forests provide recreational and aesthetic value to tourists, local communities and municipalities. According to De Groot and Van der Meer (2010), the scenery of plantation landscapes and a beautiful environment can play a role in a person's health, and therefore the local community will also benefit. Plantation forests are being recognised for providing recreational and aesthetic services, which put them and the local area on the tourism map. SAFCOL, for instance, has the Lakenvlei Forest Lodge, which offers tourists various facilities such as hiking trails, picnic sites and waterfalls. Such activities attract both local and international tourists (SAFCOL, 2017). Plantation forest companies also benefit by earning more revenue through recreational use, which can be used to take care of ES in their plantation forests.

Nutrient-cycling services were added to the CF due to the role the services play in bettering air quality, preventing soil erosion and mitigating climate change. Plantation forests play a role in preventing soil erosion and controlling dust, as tree roots stabilise the soil and foliage intercepts rainfall, thus preventing the compaction and erosion of bare soil (De Groot & Van der Meer, 2010). Plantation forests also provide better road access to local communities, local municipalities and workers. The providers of ES can be recognised for the positive effect they have on fighting global warming and bettering air quality. Nutrient cycling offers the service of maintaining a healthy soil and productive ecosystem (Blignaut *et al*., 2008)

5.3.1.2 Beneficiaries and providers of ES

It was identified that local communities, local municipalities, private entities, company workers and tourists are the beneficiaries of ES in plantation forests. The local communities benefited more from plantation forests, since most of the rural communities are located next to these forests. The communities benefit both directly through job creation and indirectly by having access to forest products and clean air. Tourists benefit from ES in plantations through recreational activities (De Groot & Van der Meer, 2010). However, according to the FSC guidelines, landowners and downstream water users are also the beneficiaries of ES in plantations. The local downstream water users can benefit from the water supplied from water bodies within the forest (FSC, 2020b). The beneficiaries of ES were identified as potential buyers of these services, which they obtain from plantation forests.

Based on both the survey and the literature, forestry companies, landowners, farmers and small growers were identified as the providers of ES in plantation forests. Local farmers and communities support ES by participating in or helping plantation forests minimise ES effects. They do so by participating in the projects provided by government and acquire knowledge of sustainable resource-use practices (FAO, 2007; Waage *et al*., 2008). According to Idol *et al*. (2011), smallholders are increasingly being recognised for providing ES. Smallholders play a role in ES through conservation and enhancement, such as creating or retaining riparian buffers, and they also create windbreaks and terraces to slow wind and water erosion.

5.3.1.3 Improving the supply of ES in plantation forests

It was agreed by the survey respondents that operations in plantations can improve the supply of ES through proper management. The study identified that good plantation management can improve the supply of ES in the form of better-quality runoff water, soil, erosion control and carbon sequestration. Through job creation and the provision of fuelwood from plantations, ES can be improved by reducing the pressure on other natural resources. According to Kubiszewski *et al*. (2017), plantations are able to establish a system that, with careful management, can provide a suitable alternative to the nutrient cycle of natural forests. In order to improve the supply of ES in plantation forests, there should be a target and monitoring programme in place, and these targets should be adjusted on a yearly basis in order to assure continual improvement.

Although the primary function of plantation forests is to produce fibre, good management practices result in a range of services that might not be available under a different land-use system. The supply of ES in plantation forests can be improved through integrated environmental management across operations, and water quality can be improved through proper wetland and riparian delineation (FSA, 2019).

5.3.2 Management of ES in plantation forests (Section B)

The study identified the key aspects that are needed to manage ES in plantation forests. These aspects will also assist in managing the complexity of PES. The CF was structured in a simple way by allocating all the responsibilities to the relevant sectors and administrators.

5.3.2.1 PES administrators

Based on both the survey results and the literature, having a PES administrator is the best way to manage a PES system. A PES administrator will help to coordinate and make sure that ES operational guideline are being followed. Having a PES scheme administrator is one of the important aspects for improving PES effectiveness. Poor administration is one of the factors that can prevent

PES schemes from being more effective (Wunder *et al*., 2010). The survey suggested that an independent agency, as opposed to a government or industry association, should be set up to administer PES in plantation forests. Involving government and donor agencies has caused many challenges around PES systems, such as budget constraints, political processes and payments that are likely to end at some point (Kerr *et al*., 2017). Due to bureaucratic processes, government is not well suited to administer PES, therefore this option was excluded based on the survey recommendations.

An independent PES administrator can be an agency strictly designed to focus on PES. Such a dedicated PES agency will be responsible for managing the system and running a register of ES and will serve as a broker between plantations and the buyers of ES. The PES agent can link and collaborate with catchment management agencies (CMAs), which will be responsible for managing water usage in the plantation forests. According to Meissner and Funke (2016), a CMA is a board governed by the government to play a critical role in managing the country's scarce water resources, including facilitating stakeholder input. Its mandate is to develop catchment-management strategies (CMS) and its purpose is to create and come up with a plan that will protect, use, develop, conserve, manage and control water resources in the respective water management areas (WMAs). Therefore, CMAs can assist PES agency to manage water-related issues and control allocations of water through water-use licencing in plantation forests.

5.3.2.2 ES operational guideline

South Africa already has an environmental guideline for plantation management, which was developed by FSA (2019). This guideline provides information on the proper management of environmental aspects and could serve as a foundation for ES management in SA. The purpose of developing FSA guidelines was to provide guidance on how to manage plantation forestry and minimise the effects of forestry operations on the physical environment (FSA, 2019). The FSA environmental guidelines could be strengthened to include the monitoring of ES.

The operational guidelines could include creation of awareness to educate workers and the local communities on how to manage ES in plantation forests. It could also include educating workers and communities on the importance of ES. The FSA guidelines include most of the best management practices that are aligned with statutory requirements to minimise the effect of forestry operations on the environment (FSA, 2019). FSC guidelines on ES effects can also be used as part of ES operational guidelines. These guidelines will improve access to the ES market through FSC ecosystem procedures (FSC, 2020a).

Both the FSA (2019) Environmental Guidelines for Commercial Forestry Plantations in SA and the FSC (2018) guidelines to demonstrate ES effects are good as part of ES operational guidelines, since they cover the basis of ES in plantation forests. Therefore, the ES operational guidelines proposed in the CF will use or include some of the aspects that are already in the FSC and FSA guidelines.

5.3.2.3 How PES will work in plantation forests

The providers of ES in plantation forests can be rewarded for providing ES through indirect payments, such as certification, recognition, carbon storage rewards, carbon tax and carbon credit trading tax, and direct payments, which are financial investments, financial sponsorship, premium prices or grants. However, this currently can only happen in FSC forest management-certified companies, which can claim for FSC ecosystem services through ES procedures (FSC, 2020b). Payments can also come from the ES beneficiaries who benefit from the services, such as downstream hydropower plants, breweries or any other companies that use the water as the main

input in their production services (FSC, 2020b). Indirect payment can work well as an incentive for smaller companies, such as tax incentives, which may also present an opportunity for rewarding carbon storage, whereby existing plantation sites may be utilised to plant more trees and maximise carbon sequestration. The Carbon Tax Act, which came into effect on 1 June 2019, provides for the imposition of a tax on the CO_2 equivalent of GHG emissions, energy-efficiency and tax incentives. In the Carbon Offsets Paper (2014), forestry, agriculture and land use were excluded for a five-year period (1 June 2019 to 31 May 2024), mainly due to administrative difficulties when verifying and measuring emissions from these sectors (FSA, 2019). This has slowed down the implementation of the Carbon Tax Act and has affected the ES negatively.

Although it was stressed that certification may prove expensive for smallholders and growers, the solution was to adopt a landscape-level approach to certification, whereby protecting and restoring natural systems across various types of land use would occur on a regional or larger-scale level. Forming co-operatives or joint efforts gives smaller players more influence and purchasing power. According to the FSC (2020c), certification costs can be reduced by forming a group with the FSC certificate holders, which makes it easier for smallholders to become FSC-certified. This grants group members economies of scale, which optimises production factors, strengthens their negotiation capacity, and allows them to share the workload and reduce the cost of achieving and maintaining an FSC certificate.

In the CF developed in this study, the rewards are grouped into two: rewards suitable for bigger companies and rewards for smaller companies. Both bigger and smaller forestry companies have different interests and goals, therefore it is important to have a suitable reward for these companies. Certification was identified as the best incentive for plantation forests due to the transparent process and standards followed with certification. Therefore, most of the companies certified are reliable and have a good reputation and, lastly, they go through audit, monitoring and evaluation processes. Certification comes with principles that play a role in protecting and maximising the ES. For example, FSC certification includes a principle of environmental value and effects, in terms of which ES are maintained, conserved and restored (FSA, 2020). According to the survey, when a plantation is certified, all the activities in the plantation forests are carried out to optimise ES. Since most of the plantation forests in SA are FSC certified, the companies can benefit by managing their plantation forests responsibly, while preserving valuable ES through the FSC ecosystem procedure. The FSC has developed new tools according to which both businesses and investors that are FSC certification holders will be rewarded through financial investment, financial sponsorship, premium prices or grants for protecting and managing ES in their plantations (FSC, 2020b). The FSC ecosystem procedure offers certificate holders access to markets and provides the financial sector with timely, audited, and localised data about the effect of their investments on ES. The rewards for providing ES can be negotiated between buyers and sellers for mutual benefit (FSC, 2020b).

5.3.2.4 Basic management of ES in plantation forests

The survey shows that forestry companies must manage, at the very minimum, their plantation forests in a legally compliant way. During the survey it was strongly recommended that illegal management in plantation forests should be handled by law enforcement. Law enforcement is already enforcing penalties for illegal management, primarily under the National Environmental Management Act (NEMA) and the Water Act. However, this will exclude water resources management penalties, which are dealt with separately in the next section.

5.3.2.5 Water management in plantation forests

Plantation forests have a major effect on hydrological processes and play an important role in the global hydrological cycle (Khanal & Devkota, 2020). In all regions of the world, PES schemes for watershed protection are being recognised by governments, investors and suppliers of domestic and industrial water. The following incentives were identified as suitable for water preservation in SA: tax incentives, streamflow reduction for forestry, and improvement of water licencing. However, for this to work, it must be shown that forest management at the watershed-management level is seen to improve water availability and quality. According to the FSA (2019), the effects of commercial timber plantations on water availability should be minimised by conserving, protecting and managing water resources. Poor forest management practices can have a huge effect on water quality (Kanowski, 2010).

According to the survey, the clearing of mountain catchment and riparian zones of invasive alien plants can help maximise water runoff. It was also indicated that, in order to have good management in plantation forests, good-quality water should be ensured by delineating streams and rivers. This can be done by following or using a guideline developed by the Department of Water Affairs and Forestry ([DWAF], 2008) to assist in saving water in SA.

5.3.2.6 PES scheme

The PES scheme proposed in the CF focused strongly on certification, since it is suitable for both small growers and big companies. The survey findings indicate that a PES system in plantation forests in SA should be based on certification at the landscape level to accommodate small growers. In addition, big plantation companies could assist small companies and small growers to adopt improved plantation management. If an FSC-certified company can offer evidence of positive effects as well as tools for communication and green marketing, the company will be rewarded through monetary and non-monetary benefits for actively managing forests and ES responsibly (FSC, 2020c). FSC certification will be an excellent tool to improve PES, provided that the mechanisms to make it easier for small growers to join continue to be developed. The scheme should include independent auditing methods to audit the state of an ecosystem to ensure there is management effectiveness. This can be audited by the FSC, as it is an independent non-governmental organisation with a vision to promote environmental protection through the environmentally, socially and economically prosperous management of the world's forests (FSC, 2020a).

A PES scheme should be operated privately. It was already explained that involving government in PES might not be feasible. Private schemes were included due to their ability to focus more on local communities and buyers who pay for the services directly (Wunder, 2005, 2007). Use-restricting PES schemes will also be included in the CF due to their ability to compensate the providers for conservation, such as fully setting aside areas like protected habitats. For example, landowners and communities could deduct the value of a protected area from their taxable income, which would reduce the amount of tax they owe each year (Birdlife.org.za, 2021).

5.3.2.7 Better management of plantation forests in SA

According to the survey, forest management culture can be improved by benchmarking best practices, better monitoring, implementing effective and user-friendly incentive schemes, and through better human resource performance management. Good management is directed by industry best practices and legal standards. With beneficiaries making contributions to the cost of management, it will also be a recognition that the social responsibility of the forest extends beyond the forest gate. A plantation forest can be managed through good land-use management that

provides a well-organised source of renewable raw materials to mitigate climate change (NGP, 2015). Plantation trees, for instance, can remove CO_2 from the atmosphere and store it in their timber and end-use products (FSA, 2020).

5.4 Implementation of the conceptual framework

First of all, in order to implement a PES scheme in the plantation, an administrator will be needed to manage the system (as described in section 5.3.2.1.). The administrators will use ES operational guidelines to ensure that plantations are following the good management standards mentioned in the CF. This will include following key management activities, the application of good management practices and maximising water quality and quantity in the plantation forests. The PES scheme will be based on certification at the landscape level to accommodate small growers. Thereby, the FSC will certify companies that show evidence of positive effects, as well as tools for communication and green marketing, and they can qualify to be rewarded through direct or indirect payments for actively managing forests and ES respectively.

The PES compensation structure to be used in this CF will include compensation funds, a legal framework, certification, an offset mechanism, inspection, auditing and verifying the general care of ES. This will be achieved by following the steps below, which will define and demarcate the kind of ES to be bought and sold identified.

- Having a clearly defined geographic boundary set for ES to be provided, to avoid confusion.
- Identifying the buyers of ES and the market in which the ES will be sold, which can either be international, national or local, and how the price will be set.
- Ensuring that the necessary governance structures for ES are in place. It will be necessary to ensure that the governance of ES is clear by understanding the existing governance systems for managing ES at the hamlet, village or landscape level.
- Identifying suitable institutions with clear ownership rights to the ES, with clear and secured property rights, strong legal frameworks, and access to resources in order for the PES system to work.
- Defining scenarios for all PES projects and collecting baseline data.
- Managing environmental sustainability, credibility, assurance, and economic, social sustainability. All these conditions will minimise sources of interference with the newly created market and reduce transaction costs.

In establishing a PES scheme, a financial mechanism must be created to gather and manage funds from beneficiaries. In theory, beneficiaries should not have to pay more than the value of the ES. However, for that to happen, PES schemes need to generate a stable and continuous flow of revenue that will sustain the system in the long term. The revenues to sustain the system can come from users' fees, direct contributions, taxes, state subsidies, donations by NGOs, and grants or loans from international institutions (Mayrands & Paquin, 2004). There will be a balance between the maximal payment that beneficiaries are willing to provide and the minimal payments that will ensure the provision of services by the plantations as provider. Keeping the transaction costs low in order to optimise the use of resources collected from beneficiaries is one of the PES challenges. The PES scheme will be monitored effectively to prove to beneficiaries that their investments are generating land-use changes in the plantations.

The rewards for plantations will be categorised into two groups: rewards for bigger companies and rewards for smaller companies, such as small growers. Indirect rewards for bigger companies

will include certification, recognition and improved environmental management, while the rewards for small companies include certification, carbon storage rewards, carbon, tax, and carbon credit trading tax. Apart from the indirect incentives listed, plantations can receive direct payments such as financial investment, financial sponsorship, premium prices or grants. This can be organised though payment for environmental services through donations and sponsorships.

PES schemes will also provide non-monetary benefits, such as training, infrastructure or support for revenue diversification or market development for the ES plantations as the sellers. This could work well when there are not enough funds to fund PES systems. The basic management of ES in the plantations should be legally compliant as a minimum, and PES will only apply if the plantation is managing the plantation better than just following the legal performance. This will include good management of the plantation following good practices, such as benchmarking and monitoring best practices, better human resources performance management, best practice and legal standards, ensuring good quality of water, and ensuring that stream and river areas are delineated.

When plantations play a role in maximising water quality and quantity, they could be rewarded through tax incentives, streamflow reduction tax for forestry, and water-use licence improvement. However, poor management of water resources in the plantation will results in water resources enforcement, whereby plantations will be forced to control usage. The power of issuing penalties can be given to catchment management agencies through an act of parliament under the Department of Environment, Forestry and Fisheries.

Chapter 6: Conclusions and recommendations

A conceptual framework (CF) for payment for environmental services (PES) in SA was developed based on a literature review, a key informant survey and a Delphi study. The CF consisted of two diagrams, with section A focusing on the interaction between stakeholders and ES in plantation forests in SA, and section B focusing on the management of the PES system developed in the CF. Section A included the recommended ES that are found in plantation forests in SA, the sellers of ES and the beneficiaries, incentives suitable for the ES and benefits that the plantation forests provide, while section B focused on the management of the plantation forests and key aspects needed to manage the ES and PES systems properly. The key aspects included in the CF to manage ES are PES system administrators, ES operational guidelines, PES rewards, water resource management, a PES scheme, and the management of plantation forests. The purpose of developing a CF was to guide discourse on the management of environmental services and payment schemes.

The study concluded that water regulation is the most important ES in plantation forests. The incentives suitable for water regulation services that were identified and chosen in this CF are tax incentives, streamflow reduction tax, and improvement of water-use licencing. According to Mayrand and Paquin (2004), watershed-based services are frequently subsidised through user fees in order to finance improved management of the protected area upstream. The penalty for water mismanagement was added to the CF. Plantation forests also depend on water, therefore it is important to include the enforcement of water resource services in PES schemes. This will also help improve forest law enforcement and governance, since the services being paid for need to be monitored (Navarro, 2014; Biénabe *et al*., 2017).

Other important ES in the plantation forests were identified as carbon sequestration, soil conservation, recreational services, renewable resources and the provisioning of raw materials. Most of these ES are part of the five ES covered by the FSC ES procedure, which are biodiversity conservation, carbon sequestration and storage, watershed services, soil conservation and recreational services (FSC, 2020b).

Certification was chosen as one of the main critical incentives to be included in the CF. It was concluded that, when a plantation is certified, all the activities in the plantation forests are carried out to optimise ES in a compliant manner. According to Rametsteiner and Simula (2003), FSC certification is an effective instrument for maintaining biodiversity. Obtaining certification can help to give a platform for both bigger companies and smaller companies to be rewarded for ES management.

Therefore, smaller companies that cannot afford certification can be included in the PES framework by adopting a landscape-level approach to certification. This will allow protection and restoring of natural systems across various types of land use at a regional or larger-scale level. Being certified will also help the smallholders' companies to be recognised and to meet the future demands for certified timbers. In addition, other incentives suitable for plantation forest companies in SA were identified as tax credits and a carbon tax, which presents an opportunity for rewarding carbon storage. Good management practices put into action will help to save ES in plantation forests, and PES will only apply if those management are being met using ES operational guidelines. This includes both the FSC Guidance for Demonstrating Ecosystem Services Impacts (FSC, 2020b) and the FSA Environmental Guidelines for Commercial Forestry Plantations in SA (FSA, 2019).

The results from the survey showed that plantation forests have both negative and positive effects on ES. The most negative effect was on water services by causing a decline in water supply and provision. The most positive effects were on the provision of raw materials and job creation.

However, improved management of plantation forests was the main solution to minimise ES effects on the plantation forests in SA.

The possible buyers of ES in commercial plantation forests were identified as water users, individuals, conservation funders, impact investors and timber purchasers. The nature of payments would depend on the nature of the transition between the buyers and the sellers of ES. This could be through a premium price, financial sponsorship, financial investment, or a grant for as long as the payment is sufficient to generate a net benefit for the sellers (FSC, 2020b). The sellers of ES in commercial forestry plantations in SA were identified as forestry companies, landowners, farmers or small growers and the government.

In conclusion, the CF developed in this study can assist in minimising the negative effect on ES in SA and motivate companies to protect ES. The framework will assist farmers and companies to understand the principles of PES and make it easier for the sellers and providers to participate in PES systems. PES systems may need to be explained clearly to the sellers and providers of ES so that they will know the best and most suitable PES system for them. This is especially needed in the case of historically disadvantaged farmers, small forestry companies and small growers.

This CF could guide and assist the plantation forest industry in SA to protect and conserve ES through a well-developed PES service scheme. Furthermore, although there are practical guidelines already established to manage PES projects, there is a need to explore strengthening them for use by PES administrators in managing PES system. Exploring such issues could be a fruitful path for future research. The guideline policy could be combined with FSA and FSC environmental guidelines to focus on the requirements for PES schemes in the plantation forests. Future research could also include government officials and interview them about their view on PES schemes and what support they these schemes should provide. Also, deeper research on the application and track record of PES in SA is recommended for future studies, as deeper research is needed to identify the practical structuring of the technical, financial and institutional aspects of the PES conceptual framework.

Recommendations from this study can be summarised as:

- Incentives can be implemented through a joint partnership between the government and the private sector by embarking on proper planning, negotiation, and development of user-friendly incentives that are mutually beneficial.
- Another way for compensation schemes to work would be to first establish sources for funding and to generate funds through issuing penalties to companies or landowners who are non-compliant with environmental regulations.
- The PES scheme should have cheaper rates and attractive incentives for companies. According to Wunder (2005), the lack of competitive PES rates is one of the challenges that can discourage people from joining the conservation scheme.
- A budget should be made available by the government for smaller companies to access the services of the administrator, and organisations smaller than a certain size should be able to claim from it, which can benefit smaller organisations in order to pay for the services required.
- It was recommended that forestry companies should ensure they are legally compliant as a minimum. PES should only reward plantation forests if they are doing more than what the law expects from them.
- Since different incentives work for different ES in plantation forests, there is a need to identify the most appropriate incentives for each need or service. For a compensation structure to work, incentives need to be relative to the value of the particular ES, or to the cost of producing that ES at the levels which buyers demand.

References

Adhikari, B. & Boag, G. 2013. Designing payments for ecosystem services schemes: Some considerations. *Current Opinion in Environmental Sustainability*, 5(1):72-77.

Adom, D., Hussain, E.K. & Agyem, J.A. 2018. Theoretical and conceptual framework: Mandatory ingredients of a quality research. *International Journal of Scientific Research*, 7(1):93-98.

Alix-Garcia, J., De Janvry, A., Sadoulet, E. & Torres, J.M. 2005. An assessment of Mexico's payment for environmental services program. A report for the United Nations Food and Agriculture Organization (FAO). Available: https://are.berkeley.edu/~esadoulet/papers/FAOPES-aug05.pdf [20, November 2020].

Babbie, E. & Mouton, J. 2001. *The practice of social research: South African edition*. Cape Town: Oxford University Press Southern Africa.

Bauhus, J. & Schmerbeck, J. 2010. Silvicultural options to enhance and use forest plantation biodiversity, in J. Bauhus, P. van der Meer & M. Kanninen (eds). *Ecosystem goods and services from plantation forests*. London & Washington, DC: Routledge. 112-155.

Bauhus, J., Pokorny, B., Van der Meer, P.J., Kanowski, P.J. & Kanninen, M. 2010. Ecosystem goods and services – The key for sustainable plantations, in J. Bauhus, P. van der Meer & M. Kanninen, (eds). *Ecosystem goods and services from plantation forests*. London & Washington, DC: Routledge. 221-243.

Besar, N.A., Suardi, H., Phua, M.H., James, D., Mokhtar, M.B. & Ahmed, M.F. 2020. Carbon stock and sequestration potential of an agroforestry system in Sabah, Malaysia. *Forests*, 11(2):210. https://doi.org/10.3390/f11020210

Biénabe, E., Dutilly, C., Karsenty, A. & Le Coq, JF. 2017. Ecosystem services, payments for environmental services, and agri-chains: What kind of regulation to enhance sustainability? in E. Biénabe, A. Rival & D. Loeillet (eds). *Sustainable development and tropical agri-chains.* Dordrecht: Springer. https://doi.org/10.1007/978-94-024-1016-7_24

Birdlife.org.za. 2021. *Biodiversity tax incentives policy and advocacy* [Online]. Available: https://www.birdlife.org.za/what-we-do/policy-and-advocacy/what-we-do/policy/tax-incentives/ [2021, February 3].

Bless, C., Higson-Smith, C. & Kagee, A. 2006. *Fundamentals of social research methods: An African perspective*. Cape Town: Juta and Company Ltd.

Blignaut, J., Marais, C., Rouget, M., Mander, M., Turpie, J., Klassen, T. & Preston, G. 2008. Making markets work for people and the environment: Employment creation from payment for eco-systems services. Combating environmental degradation and poverty on a single budget while delivering real services to real people. Pretoria: South African Government.

Blundo-Canto, G., Bax, V., Quintero, M., Cruz-Garcia, G.S., Groeneveld, R.A. & Perez-Marulanda, L. 2018. The different dimensions of livelihood impacts of payments for environmental services (PES) schemes: A systematic review. *Ecological Economics*, 149:160-183.

Borges, B. 2011, April 25. Defining payments for ecosystem services. *Forest Trends blog* [Web log post]. Available: https://www.forest-trends.org/publications/defining-payments-for-ecosystem-services/ [2020, November 12].

Börner, J., Baylis, K., Corbera, E., Ezzine-de-Blas, D., Honey-Rosés, J., Persson, U.M. & Wunder, S. 2017. The effectiveness of payments for environmental services. *World Development*, 96:359-374

Böttcher, H. & Lindner, M. 2010. Managing forest plantations for carbon sequestration today and in the future, in J. Bauhus, P. van der Meer & M. Kanninen (eds). *Ecosystem goods and services from plantation forests*. London & Washington, DC: Routledge. 59-92.

Brockerhoff, E.G., Jactel, H., Parrotta, J.A., Quine, C.P. & Sayer, J. 2008. Plantation forests and biodiversity: Oxymoron or opportunity. *Biodiversity and Conservation*, 17(5):925-951.

Brouwer, R., Tesfaye, A. & Pauw, P. 2011. Meta-analysis of institutional-economic factors explaining the environmental performance of payments for watershed services. *Environmental Conservation*, 38(4):380-392.

Budhi, G.S., Kuswanto, S.A. & Iqbal, M. 2016. Concept and implementation of PES program in the Cidanau watershed: A lesson learned for future environmental policy. *Analisis Kebijakan Pertanian*, 6(1):37-55.

Buric, B., Gault, J. & Bertoye, F. 2011. *Payment for environmental services: First global inventory of schemes provisioning water for cities*. Rome: Food and Agriculture Organisation (FAO) Natural Resources Management and Environment Department Land and Water Division.

Carnus, J.M., Parrotta, J., Brockerhoff, E., Arbez, M., Jactel, H., Kremer, A., Lamb, D., O'Hara, K. & Walters, B. 2006. Planted forests and biodiversity. *Journal of Forestry*, 104(2):65-77.

Chaudhury, M. 2009a. Assessing the protection of forest-based environmental services in the Greater Mekong subregion. FAO Regional Office for Asia and the Pacific Working Paper No. APFSOS II/WP/2009/14, Bangkok, FAO.

Chaudhury, M. 2009b. Valuing services: An analysis of the ability and willingness to protect forest-based environmental services in the Asia-Pacific Region. FAO Regional Office for Asia and the Pacific Working Paper No. APFSOS II/WP/2009/16, Bangkok, FAO.

Chun Tie, Y., Birks, M. & Francis, K. 2019. Grounded theory research: A design framework for novice researchers. *SAGE Open Medicine*, 7:1-8. https://doi.org/10.1177/2050312118822927

Corbera, E., Soberanis, C.G. & Brown, K. 2009. Institutional dimensions of payments for ecosystem services: An analysis of Mexico's carbon forestry programme. *Ecological Economics*, 68(3):743-761.

Critchley, W.R.S. & Bruijnzeel, L.A. 1996. Environmental impacts of converting moist tropical forest to agriculture and plantations. UNESCO & IHP Humid Tropics Programme Series No. 10, Delft, The Netherlands. https://unesdoc.unesco.org/ark:/48223/pf0000109608

Da Silva, R.F.B., Rodrigues, M.D.A., Vieira, S.A., Batistella, M. & Farinaci, J. 2017. Perspectives for environmental conservation and ecosystem services on coupled rural–urban systems. *Perspectives in Ecology and Conservation*, 15(2):74-81

Day, J. & Bobeva, M. 2005. A generic toolkit for the successful management of Delphi studies. *The Electronic Journal of Business Research Methodology*, 3(2):103-116.

De Groot, R.S. 1992. *Functions of nature: Evaluation of nature in environmental planning, management and decision-making*. Groningen, The Netherlands: Wolters Noordhoff BV.

De Groot, R.S. & Van der Meer, P.J. 2010. Quantifying and valuing goods and services provided by plantation forests, in J. Bauhus, P. van der Meer & M. Kanninen (eds), *Ecosystem goods and services from plantation forests*. London: Earthscan. 16-42.

De Groot, R.S., Perk, J., van der, Chiesura, A., Marguliew, S. 2000. Ecological functions and socio-economic values of critical natural capital as a measure for ecological integrity and environmental health. In: Crabbe, P. (Ed.), *Implementing Ecological Integrity*. ´ Kluwer Academic Publishers, pp. 191–214.

De Groot, R.S., Wilson, M.A. & Boumans, R.M. 2002. A typology for the classification, description and valuation of ecosystem functions, goods and services. *Ecological Economics*, 41(3):393-408.

Department of Agriculture, Forestry and Fisheries. 2012. *Report on commercial timber resources and primary roundwood processing in South Africa, 2010/2011*. Pretoria: Directorate Forestry Regulation and Oversight.

Department of Water Affairs and Forestry (DWAF). 2008. Updated manual for the identification and delineation of wetlands and riparian areas. Unpublished report. Stream Flow Reduction Activities, Department of Water Affairs and Forestry, Pretoria, South Africa.

Elzaki, E. & Tian, G. 2020. Economic evaluation of the honey yield from four forest tree species and the future prospect of the forest beekeeping in Sudan. *Agroforestry Systems*, 94(3):1037-1045.

Engel, S. 2016. The devil in the detail: A practical guide on designing payments for environmental services. *International Review of Environmental and Resource Economics*, 9(1-2):131-177.

Engel, S., Pagiola, S. & Wunder, S. 2008. Designing payments for environmental services in theory and practice: An overview of the issues. *Ecological Economics*, 65(4):663-674.

Explorable.com. 2009. Snowball sampling [Online]. Available: https://explorable.com/snowball-sampling [2020, October 22].

FAO. 2007. The state of food and agriculture. Paying farmers for environmental services. FAO Agriculture Series No. 38, Food and Agriculture Organization of the United Nations, Rome.

FAO. 2010. *Planted forests in sustainable forest management – A statement of principles*. www.fao.org/forestry/plantedforests

FAO. 2016. *Payments for forest environmental services in sub-Saharan Africa: A practical guide*. Accra, Ghana: FAO.

FP&M SETA. 2014. *Forestry and Wood Products Sector: A profile of the forestry and wood products sub-sector* [Online]. Available: https://www.fpmseta.org.za/downloads/FPM_sub-sector_forestry_wood_final.pdf [2020, December 3].

Fripp, E. 2014. *Payments for ecosystem services (PES): A practical guide to assessing the feasibility of PES projects*. Bogor, Indonesia: CIFOR.

Forestry Economics Services (FEC). Dept. of agriculture, forestry and fisheries forestry & natural resources management branch. 2012. *Report on commercial timber resources and primary roundwood processing in South Africa*. Directorate: Forestry Regulation and Oversight, Pretoria: SA.

Forestry SA (FSA), 2018. *17th annual report for the year ended 31st December 2018* [Online]. Available: https://www.forestrysouthafrica.co.za/wp-content/uploads/2019/06/FSA-Annual-report-2019-colour-version.pdf [30/11/2020].

Forestry SA (FSA), 2019. *Environmental guidelines for commercial forestry plantations in South Africa, revision 3* [Online]. Available: https://www.forestry.co.za/uploads/File/industry_info/environment/Environmental%20Guidlines%20for%20Commercial%20Forestry%20Plantations%20in%20South%20Africa%20-%202019%20(low%20res).pdf [2020, October 24].

Forestry SA (FSA). 2020. *Forestry South Africa | Representing the forestry industry* [Online]. Available: https://forestryexplained.co.za/ [2020, October 23].

Forestry SA (FSA). 2021. Why water is regulated in forestry? [Online]. Available: https://www.forestrysouthafrica.co.za/info-graphics/water-regulations/ [2021, February 7].

Forest Stewardship Council (FSC). 2020a. *FSC ecosystem services factsheet* [Online]. Available: https://ic.fsc.org/file-download.fsc-ecosystem-services-factsheet-04-2018.a-7424.pdf [2020, November 30].

Forest Stewardship Council (FSC). 2020b. *Guidance for demonstrating ecosystem services impacts* [Online]. Available: https://webcache.googleusercontent.com/search?q=cache:KcV6b4jPJSYJ:https://fsc.org/en/document-centre/documents/resource/336+&cd=2&hl=en&ct=clnk&gl=za [2020, November 30].

Forest Stewardship Council (FSC). 2020c. *Forest certification: What's it all about?* [Online]. Available: https://www.forestrysouthafrica.co.za/wp-content/uploads/2016/03/Certification-PRINT.pdf [2020, October 12].

Geldenhuys, C.J. 1997. Native forest regeneration in pine and eucalypt plantations in Northern Province, South Africa. *Forest Ecology and Management*, 99(1):101-115.

Ham, C. 2000. *Importance of woodlots to local communities, small scale entrepreneurs and indigenous forest conservation – A case study*. Stellenbosch: IIED & CSIR.

Hasson, F., Keeney, S. & McKenna, H. 2000. Research guidelines for the Delphi survey technique. *Journal of Advanced Nursing*, 32(4):1008-1015.

Hayes, T., Murtinho, F. & Wolff, H. 2017. The impact of payments for environmental services on communal lands: an analysis of the factors driving household land-use behavior in Ecuador. *World Development*, 93:427-446.

Huang, M. & Upadhyaya, S.K. 2007. Watershed-based payment for environmental services in Asia. Working Paper No. 06-07, Sustainable Agriculture and Natural Resource Management Collaborative Research Support Program (SANREM CRSP), Office of International Research, Education, and Development (OIRED), Virginia Tech.

Idol, T., Haggar, J. & Cox, L. 2011. Ecosystem services from smallholder forestry and agroforestry in the tropics, in W.B. Campbell & S.L. Ortíz (eds). *Integrating agriculture, conservation and ecotourism: Examples from the field*. Dordrecht: Springer. 209-270.

Ingram, V., Van der Werf, E., Kikulwe, E. & Wesseler, J.H.H. 2016. Evaluating the impacts of plantations and associated forestry operations in Africa – Methods and indicators. *International Forestry Review*, 18(1):44-55.

Island Press. 2006. *Millennium ecosystem assessment. A toolkit for understanding and action: Protecting nature's services. Protecting ourselves*. http://www.truevaluemetrics.org/DBpdfs/EcoSystem/MEA/MEA-Millennium-Ecosystem-Assessment-Toolkit.pdf

Jabareen, Y. 2009. Building a conceptual framework: Philosophy, definitions, and procedure. *International Journal of Qualitative Methods*, 8(4):49-62.

Jack, B.K., Kousky, C. & Sims, K.R. 2008. Designing payments for ecosystem services: Lessons from previous experience with incentive-based mechanisms. *Proceedings of the National Academy of Sciences,* 105(28):9465-9470.

Kanninen, M. 2010. Plantation forests: Global perspectives, in J. Bauhus, P. van der Meer & M. Kanninen (eds). *Ecosystem goods and services from plantation forests*. London & Washington, DC: Routledge. 17-31.

Kanowski, P.J. 2010. Policies to enhance the provision of ecosystem goods and services from plantation forests, in J. Bauhus, P. van der Meer & M. Kanninen (eds). *Ecosystem goods and services from plantation forests*. London & Washington, DC: Routledge. 187-220.

Keenan, R.J. & Van Dijk, A.I.J.M. 2010. Planted forests and water, in J. Bauhus, P. van der Meer & M. Kanninen (eds). *Ecosystem goods and services from plantation forests*. London & Washington, DC: Earthscan. 77-95.

Kerr, J.M., Lapinski, M.K., Liu, R.W. & Zhao, J. 2017. Long-term effects of payments for environmental services: Combining insights from communication and economics. *Sustainability*, 9(9):1627.

Khanal, Y. & Devkota, B.P. 2020. Farmers' responsibilization in payment for environmental services: Lessons from community forestry in Nepal. *Forest Policy and Economics*, 118:102237.

Kubiszewski, I., Costanza, R., Anderson, S. & Sutton, P. 2017. The future value of ecosystem services: Global scenarios and national implications. *Ecosystem Services*, 26:289-301.

Landell-Mills, N. & Porras, I.T. 2002. *Silver bullet or fools' gold? A global review of markets for forest environmental services and their impact on the poor*. London: International Institute for Environment and Development.

Laurans, Y., Leménager, T. & Aoubid, S. 2012. *Payments for ecosystem services: From theory to practice – What are the prospects for developing countries?* Agence française de développement. https://www.afd.fr/en/ressources/payments-ecosystem-services-theory-practice-what-are-prospects-developing-countries

MacCarthy, B.L. & Atthirawong, W. 2003. Factors affecting location decisions in international operations – A Delphi study. *International Journal of Operations & Production Management*, 23(7):794-818.

Maginnis, S. & Pollard, D. 2006. Forest plantations: The good, the bad and the ugly. *Arborvitea-IUCN-WWF Forest Conservation Newsletter*, 31:1.

Mander, M. 2012. Forestry and ecosystem services, in R. Bredenkamp & S.J. Upfold (eds). *South African forestry handbook*. 5th edition. South Africa: South African Institute for Forestry.

Mayrand, K. & Paquin, M. 2004. *Payments for environmental services: A survey and assessment of current schemes* [Online]. Available: https://vtechworks.lib.vt.edu/handle/10919/66935 [2020, November 24].

Meissner, R., N. Funke, and K. Nortje. 2016. The politics of establishing catchment management agencies in South Africa: the case of the Breede-Overberg Catchment Management Agency. Ecology and Society 21(3):26. http://dx.doi.org/10.5751/ES-08417-210326

Milder, J., Scherr, S. & Bracer, C. 2010. Trends and future potential of payment for ecosystem services to alleviate rural poverty in developing countries. *Ecology and Society,* 15(2):4.

Miranda, M., Porras, I.T. & Moreno, M.L. 2003. *The social impacts of payments for environmental services in Costa Rica. A quantitative field survey and analysis of the Virilla watershed*. London: International Institute for Environment and Development.

Monash. 2020. *Conceptual framework on child literacy research source* [Online]. Available: http:// www.monash.edu.au/lls/hdr/design/2.2.1.html [2020, October 23].

Mondi Group. 2019. *Sustainable by design makes us Mondi: Sustainable development report* [Online]. Available: https://www.mondigroup.com/media/11728/mondi_2019_sustainable_development_report.pdf [2020, November 24].

Navarro, G. 2014. Payment of environmental services (PES) schemes must be part of a broader business model. *ITTO Tropical Forest Update*, 23(1):1-33.

National Treasury. 2014. *Carbon offsets paper (published for public comment)*. Pretoria: Government Printer.

New Generation Plantations (NGP), 2015. *Annual meeting: Plantations for pPeople: Thinking at a landscape level* [Online]. Available: https://newgenerationplantations.org/multimedia/file/eba831b0-b5e8-11e4-9137-005056986313/ [2020, December 9].

Nworie, J. 2011. Using the Delphi technique in educational technology research. *TechTrends*, 55(5):24.

Nyongesa, J.M. 2017. Determining farmer's preferences for land use practices under payment for environmental services in Lake Naivasha basin-Kenya. *African Journal of Rural Development*, 2(3):389-402.

Osuri, A.M., Gopal, A., Raman, T.S., DeFries, R., Cook-Patton, S.C. & Naeem, S. 2020. Greater stability of carbon capture in species-rich natural forests compared to species-poor plantations. *Environmental Research Letters*, 15(3):034011.

Pagiola, S. 2008. Payments for environmental services in Costa Rica. *Ecological Economics*, 65(4):712-724.

Pagiola, S., Von Ritter, K. & Bishop, J. 2004. *Assessing the economic value of ecosystem conservation*. Washington DC: World Bank.

Paquette, A. & Messier, C. 2010. The role of plantations in managing the world's forests in the Anthropocene. *Frontiers in Ecology and the Environment*, 8(1):27-34.

Pokorny, B., Hoch, L. & Maturana, J. 2010. Smallholder plantations in the tropics – Local people between outgrower schemes and reforestation programmes, in J. Bauhus, P. van der Meer & M. Kanninen (eds). *Ecosystem goods and services from plantation forests*. London & Washington, DC: Routledge. 156-186.

Porras, I. & Neves, N. 2006. *Costa Rica-National PES programme: Costa Rica's payment for environmental services (PES) Programme-a financial mechanism for the recuperation and conservation of forest cover in Costa Rica*. London: International Institute.

Rametsteiner, E. & Simula, M. 2003. Forest certification – An instrument to promote sustainable forest management. *Journal of Environmental Management*, 67(1): 87-98.

Ranacher, L., Lähtinen, K., Järvinen, E. & Toppinen, A. 2017. Perceptions of the general public on forest sector responsibility: A survey related to ecosystem services and forest sector business impacts in four European countries. *Forest Policy and Economics*, 78:180-189.

Robson, C. 2002. *Real world research: A resource for social scientists and practitioner-researchers*. Oxford, UK: Wiley-Blackwell.

Rosoman, G. 1994. The plantation effect: An ecoforestry review of the environmental effects of exotic monoculture tree plantations in Aotearoa/New Zealand. Greenpeace New Zealand. http://www.redd-monitor.org/wp-content/uploads/2015/08/The_Plantation_Effect.pdf

SABIE. 2006. *Forestry* [Online]. Available: https://www.sabie.co.za/about/forestry/ [2020, October 23].

SAFCOL. 2017. *SAFCOL Integrated Report* [Online], Available: http://www.safcol.co.za/wp-content/uploads/2019/05/SAFCOL-INTEGRATED-REPORT-20172018-FINAL-WEB.pdf [2020, November 24].

SANBI, 2019. *A greater Cape Town water fund for ecological infrastructure* [Online]. Available: https://www.sanbi.org/cape/a-greater-cape-town-water-fund-for-ecological-infrastructure/ [2021, February 06].

Sappi. 2019. *Mutualism: Sustainability report* [Online]. Available: https://sappi-reports.co.za/reports/sappi-gsr-2019/index.php [2020, November 24].

Sarkissian, A.J., Brook, R.M., Talhouk, S.N. & Hockiey, N. 2017. Asset-building payments for ecosystem services: assessing landowner perceptions of reforestation incentives in Lebanon. *Forest Systems*, 26(2):1.

Sattler, C. & Matzdorf, B. 2013. PES in a nutshell: From definitions and origins to PES in practice – Approaches, design process and innovative aspects. *Ecosystem Services*, 6:2-11.

Shackleton, C.M., Shackleton, S.E., Buiten, E. & Bird, N. 2007. The importance of dry woodlands and forests in rural livelihoods and poverty alleviation in South Africa. *Forest Policy and Economics*, 9(5):558-577.

Sherbut, G. 2011. Trade and industrial policy strategies [Online]. Available: www.tips.org.za [2017, June 20].

Singh, S. 2013. Payments for ecosystem services (PES) in India from the bottom-up. *Ecological Economics from the Ground Up*, 390.

Skulmoski, G.J., Hartman, F.T. & Krahn, J. 2007. The Delphi method for graduate research. *Journal of Information Technology Education: Research*, 6:1-21.

South African Government. 2017. *Forest policy discussion document* [Online]. Available: https://www.gov.za/documents/forest-policy-discussion-document [2020, November 24].

South African Government. 2020. *Forestry | South African Government* [Online]. Available: https://www.gov.za/about-sa/forestry [2020, October 23].

Swaen, B. 2020. *Developing a conceptual framework for research (Sample)* [Online]. Available: https://www.scribbr.com/dissertation/conceptual-framework/ [2020, October 23].

Swallow B. & Meinzen-Dick R. 2009. Payment for environmental services: Interactions with property rights and collective action, in: V. Beckmann & M. Padmanabhan (eds). *Institutions and sustainability*. Dordrecht: Springer. https://doi.org/10.1007/978-1-4020-9690-7_12

Turpie, J.K., Marais, C. & Blignaut, J.N. 2008. The working for water programme: Evolution of a payments for ecosystem services mechanism that addresses both poverty and ecosystem service delivery in South Africa. *Ecological Economics*, 65(4):788-798.

Waage, S., Bracer, C. & Inbar, M. 2008. Payments for ecosystem services: Getting started. A primer. Washington DC: Forest Trends and The Katoomba Group.

Wunder, S. & Albán, M. 2008. Decentralized payments for environmental services: The cases of Pimampiro and PROFAFOR in Ecuador. *Ecological Economics*, 65(4):685-698.

Wunder, S. 2005. *Payments for environmental services: Some nuts and bolts*. Jakarta, Indonesia: Center for International Forestry Research.

Wunder, S. 2007. The efficiency of payments for environmental services in tropical conservation. *Conservation Biology*, 21(1):48-58.

Wunder, S. 2008. Payments for environmental services and the poor: Concepts and preliminary evidence. *Environment and Development Economics*, 13(3):279-297.

Wunder, S., Wertz-Kanounnikoff, S. & Ferraro, P. 2010. *Payments for environmental services and the global environment facility: A STAP advisory document*. Nairobi, Kenya: Scientific and Technical Advisory Panel.

Appendix 1: Key informant questionnaire

CONSENT TO PARTICIPATE IN RESEARCH

Dear fellow participants

My name is Mulalo Charmaine Munarini and I am a Stellenbosch University student, doing my Masters in the Forestry and Wood Science Department. I would like to invite you to participate in a survey, the results of which will contribute towards my research project entitled "A conceptual framework for Environmental Payment in South Africa plantation forests".

Please take some time to read the information presented here, which will explain the details of this project.

Your participation is entirely voluntary, and you are free to decline to participate. If you say no, this will not affect you negatively in any way whatsoever. You are also free to withdraw from the study at any point, even if you do agree to take part.

The purpose of this study is to develop a conceptual framework for environmental service payment in South Africa plantation forests. This study aims to define the concepts and review different types of payment of environmental services schemes. The outcomes of the study can be used to assist forestry companies in South Africa to protect and conserve environmental services through well-developed payment of environmental services schemes.

The questionnaires will take approximately 20 minutes to complete and will contain a combination of questions covering aspects about the payment of environmental services provided by commercial forestry plantations in South Africa. The questions will also be based on the environmental services in and from your plantations, how you value the environmental services from your plantation and current payment of environmental services in plantation forests.

There will be no remuneration for your participation.

RIGHTS OF RESEARCH PARTICIPANTS:

You have the right to decline answering any questions and you can exit the survey at any time without giving a reason. You are not waiving any legal claims, rights or remedies because of your participation in this research study. If you have questions regarding your rights as a research participant, contact Mrs Maléne Fouché [mfouche@sun.ac.za; 021 808 4622] at the Division for Research Development.

Your information and response to the survey will be protected and stored online. I am the only one who will have access to the data and your privacy and confidentiality will not be compromised in any way.

If you have any questions or concerns about the research, please feel free to contact Mrs Mulalo Charmaine Munarini [1745829@sun.ac.za; 076 766 3567] or Mr Cori Ham [cori@sun.ac.za; 082 771 9540].

To save a copy of this text, please complete the checklist below and send it to 1745829@sun.ac.za

I confirm that I have read and understood the information provided for the current study.	YES	NO
	☐	☐
I agree to take part in this survey.	YES	NO
	☐	☐

A conceptual framework for Environmental Services Payments in South African plantation forests

MSc Forestry Project

University of Stellenbosch

Background

Plantation forests contribute in supplying environmental services (ES) such as biodiversity conservation, landscape beauty, recreation, water regulation and carbon storage. ES are defined as the products and services from ecological systems that generate quality of life. They are benefits that humans obtain, enjoy, consume and use from the environment free of charge and play a significant part in the earth's climate directive to filter wastes and pollutants.

Plantations could potentially also have negative impacts on the environment such as loss of soil productivity, disruption of local water cycles and impacts on biodiversity. Payment for Environmental Services (PES) schemes could serve as an instrument to balance the positive and negative impacts of plantations on environmental services.

PES is an attractive conservation tool used to preserve and restore environmental services, whereby the user of ES pays the provider to supply the services. PES has been successfully used around the world to conserve and protect ES. The aim of this study is to develop a conceptual framework for a PES system in South African forestry plantations.

The purpose of conducting a Delphi study is to test the ideas related to this framework amongst a panel of experts. The study will include a small number of experts in the ES field (approximately five to ten experts) who will be asked to respond to a set of questions aimed at improving and building the conceptual framework.

The survey will ask the participants to give opinion about PES system and challenges around it and to criticize the draft conceptual framework. The Delphi study and other information collected from experts will be used to refine the draft conceptual framework for PES in forestry in South Africa.

Kindly assist me with this study by completing the questionnaire and e-mail it back to 17415829@sun.ac.za. Please feel free to contact me at the mentioned e-mail address.

Please note, information provided will be treated with the highest degree of confidentiality.

SECTION A: Environmental Services in plantation forests

Instructions: Please mark the appropriate block with an X or write your answer in the provided space where applicable.

Please rate from 1 to 4 the relevance of the following environmental services and products to your organization (1. No relevance 2. Some relevance 3. Relevance 4. Very relevant)	
Environmental services (ES) and products	**Ratings**
Carbon sequestration e.g. carbon storage in biomass of trees/soil.	
Climate regulation e.g. Greenhouse gas balance.	
Natural hazard regulation e.g. reduction of storm and flood damage.	
Air quality regulation e.g. Capturing dust and clean air	
Erosion prevention and soil retention e.g. tree roots stabilize the soil to prevent compaction and soil erosion and prevention of landslides.	
Water quality regulation e.g. filtering of rain water and run-off water.	
Water supply e.g. store water in streams, lakes and aquifers.	
Nutrient cycling e.g. maintenance of healthy soil, productive ecosystems and recycling of nutrients such as Nitrogen, Phosphorus and Sulphur.	
Provisioning of raw materials e.g. fibre and timber.	
Energy resources e.g. fuel wood and biofuels.	
Waste treatment e.g. pollution control/detoxifications and abatement of noise pollution.	
Genetic resources e.g. provide genes for resistance to plant pathogens.	
Plant pollination e.g. providing habitat for pollinators of commercial crops and plants.	
Aesthetic information (non-recreational enjoyment of scenery) e.g. appreciation of natural beauty such as bird watching.	
Recreational use (opportunities for tourism and recreational activities) e.g. walking, hiking, camping and fishing.	
Nursery function e.g. provide breeding and nursery areas to species harvested for commercial purposes.	
Other, specify:	

SECTION B: Environmental services from plantations

Do you think that plantation operations can improve the supply of ES?	
YES:	NO:
Please elaborate on your answer.	
2. Do you think that plantation operations can negatively affect the supply of ES?	
YES:	NO:
Please elaborate on your answer.	
3. How do you think can potential negative effects of plantation operations on the supply of ES, be minimized?	
4. How can positively effects of plantation operations on the supply of ES be enhanced?	
5. Does your company monitor the supply of ES from plantations?	
YES:	NO:
If yes, please explain.	

SECTION C: Valuing environmental services from plantations

Who are the beneficiaries of ES from your plantations? Select all that apply					
Local community:	Local municipality:	National government:	Tourists:	Private entities:	Company workers:
Other:	Please specify other:				

Does your company receive an incentive/reward or subsidy for protecting or providing ES?	
YES:	NO:
If yes, what kind of incentive/reward?	

Do you think that plantation companies in general should be compensated for ES they provide?	
YES:	NO:

Can paying or compensating for provision of ES help to conserve, sustain and restore the ES?	
YES:	NO:
If yes, how can plantation companies conserve and preserve ES?	

Does your company participate in the following projects? Select all that apply		
Carbon credit trading:	Carbon offsetting:	REDD+ (Reducing emission from deforestation and forest degradation)
Other:	Please specify other:	

If the answer in question 5 is yes, please specify the type of project.
Do you know of any “penalties” that forestry companies pay for negative impacts on ES?
If there are such penalties, are they working or fulfilling their intended objectives?

SECTION D: Payment for environmental services in plantation forests

What sort of “payments” do you think will be most appropriate for forestry companies? Please select all that apply				
Direct financial payment	Certification	Tax credit	Offsetting “penalties	Recognition/Image
Other:	Please specify other:			
How do you think can a South African based PES system work for plantations?				
Who do you think should manage a PES system?				
Is your company part of a PES scheme?				
YES:		NO:		

If yes, please describe it in short.	
Do you know of any examples of PES in a forestry context?	
YES:	NO:
If yes, please describe it in short.	
Do you know of any South African experts in ES and PES?	
YES:	NO:
If yes, please provide their names and contact details.	

Appendix 2: Delphi questionnaires

Delphi study first questionnaire

CONSENT TO PARTICIPATE IN RESEARCH

Dear fellow participants

My name is Mulalo Charmaine Munarini and I am a Stellenbosch University student, doing my Masters in the Forestry and Wood Science Department. I would like to invite you to participate in a survey, the results of which will contribute towards my research project entitled "A conceptual framework for Environmental Payment in South Africa plantation forests".

Please take some time to read the information presented here, which will explain the details of this project.

Your participation is entirely voluntary, and you are free to decline to participate. If you say no, this will not affect you negatively in any way whatsoever. You are also free to withdraw from the study at any point, even if you do agree to take part.

The purpose of this study is to develop a conceptual framework for environmental service payment in South Africa plantation forests. This study aims to define the concepts and review different types of payment of environmental services schemes. The outcomes of the study can be used to assist forestry companies in South Africa to protect and conserve environmental services through well-developed payment of environmental services schemes.

The questionnaires will take approximately 10 minutes to complete and will contain a report summary of Key informant survey done previously on this study, a draft of conceptual framework for Payment of Environmental services and a Delphi questionnaire. Data collected during Delphi survey will be used to edit and finalise a conceptual framework for PES for commercial forestry in South Africa. Outcomes of the study can hopefully be used to assist and inform the forestry industry in the development of a functional PES system for South Africa.

There will be no remuneration for your participation.

RIGHTS OF RESEARCH PARTICIPANTS:

You have the right to decline answering any questions and you can exit the survey at any time without giving a reason. You are not waiving any legal claims, rights or remedies because of your participation in this research study. If you have questions regarding your rights as a research participant, contact Mrs Maléne Fouché [mfouche@sun.ac.za; 021 808 4622] at the Division for Research Development.

Your information and response to the survey will be protected and stored online. I am the only one who will have access to the data and your privacy and confidentiality will not be compromised in any way.

If you have any questions or concerns about the research, please feel free to contact Mrs Mulalo Charmaine Munarini [17415829@sun.ac.za; 076 766 3567] or Mr Cori Ham [cori@sun.ac.za; 082 771 9540].

To save a copy of this text, please complete the checklist below and send it to 1745829@sun.ac.za

I confirm that I have read and understood the information provided for the current study.	**YES**	**NO**
	☐	☐
I agree to take part in this survey.	**YES**	**NO**
	☐	☐

A conceptual framework for Environmental Services Payments in South African plantation forests

MSc Forestry Project

University of Stellenbosch

Background

Plantation forests contribute in supplying environmental services (ES) such as biodiversity conservation, landscape beauty, recreation, water regulation and carbon storage. ES are defined as the products and services from ecological systems that generate quality of life. They are benefit that humans obtain, enjoy, consume and use from the environment free of charge and play a significant part in the earth's climate directive to filter wastes and pollutants.

Plantations could potentially also have negative impacts on the environment such as loss of soil productivity, disruption of local water cycles and impacts on biodiversity. Payment for Environmental Services (PES) schemes could serve as an instrument to balance the positive and negative impacts of plantations on environmental services.

PES is an attractive conservation tool used to preserve and restore environmental services, whereby the user of ES pays the provider to supply the services. PES has been successfully used around the world to conserve and protect ES. The aim of this study is to develop a conceptual framework for a PES system in South African forestry plantations.

The purpose of conducting a Delphi study is to test the ideas related to this framework amongst a panel of experts. The study will include a small number of experts in the ES field (approximately five to ten experts) who will be asked to respond to a set of questions aimed at improving and building the conceptual framework.

The survey will ask the participants to give opinion about PES system and challenges around it and to criticize the draft conceptual framework. The Delphi study and other information collected from experts will be used to refine the draft conceptual framework for PES in forestry in South Africa.

Kindly assist me with this study by completing the questionnaire and e-mail it back to 17415829@sun.ac.za. Please feel free to contact me at the mentioned e-mail address.

Please note, information provided will be treated with the highest degree of confidentiality.

Delphi study first round questionnaire

Participants in the key informant survey indicated that monetary and non-monetary incentives such as tax incentives, FSC certification, recognition, tax credit, trading and REDD+ will increase the flow of ES from plantations. Do you think these incentives are relevant and suitable for the plantation forests sector?	
YES:	NO:
Please elaborate on your answer.	
The survey found that there is an absence of incentives to preserve Environmental Services in the plantation forests sector. Do you agree with this observation?	
YES:	NO:
If yes, please motivate your answer by referring to why you think there a lack of incentives in the plantation forests	
How can these incentives in the plantation forests be implemented?	
Majority of the key informant respondents indicated that compensation(s) can motivate companies to protect the environment. In your opinion, how can compensation schemes be best structured to work?	
Should a PES scheme only focus on compensation, or should there also be a penalty for the mismanagement of ES? If so, how do you think such a penalty could be incorporated?	
YES:	NO:
Please explain	
The survey identified environmental services such as carbon sequestration, provisioning of raw materials, energy resources, nutrient cycling, air quality, climate regulations, erosion prevention and aesthetic preservation as relevant key pillars to be included in a PES scheme. Are there other ES that could play an important role in a PES scheme?	
YES:	NO:
Please explain.	

According to your understanding please explain how forestry companies will benefit from PES in SA for providing ES?
Based on the survey, communities, society, national government, workers, and tourists are the beneficiaries of ES provided by plantation forests. According to your understanding how will the communities, government, workers, and tourists benefit from PES in SA?
Good management emerged as a key aspect in several responses to the key informant survey as a solution to many challenges faced in the supply of ES. Do you agree with observation? If so, how could one improve the current management culture in the plantation sector?
. What are the key issues that can affect the implementation of a PES system in SA?
. Key stakeholders in a PES schemes were identified to be government, forestry industry association, communities, independent agencies, and plantation companies. According to your opinion who will be best placed to administer a PES scheme?
. Water was identified as the biggest challenge in plantation forests. What rewards and penalties can be put in place to preserve water?
Please explain.
. The conceptual framework attached was drafted based on the finding during key informant interview.
Do you agree with the conceptual framework diagram presented in the background document? If not, how do you think should a PES framework look?
From the above framework what should be added and what should be removed?

Thank you for your time.

Delphi study second round questionnaire

Delphi study second round questionnaire

Question 1: The role of certification was highlighted as a way of improving ES. It was mentioned that it is already playing an important role in ES protection and could serve as a reward for forestry companies.
Do you think that certification could be the main drivers for a PES system?
How can one bring smaller companies/ out growers that cannot afford certification or carbon credit schemes into a PES framework?
Question 2: The lack of a national policy/ framework dealing with ES was highlighted. What should be the focus of a national policy program on PES?
Question 3: It was highlighted that incentives in plantation forests can be implemented through a joint partnership between the government and private sector embarking on proper planning, negotiation, and development of user-friendly incentives that are mutually beneficial. Can you think of a way to capture the complexities of a PES in a simple but effective system?
Question 4: Management culture was highlighted as the best way to improve plantations through benchmarking best practices, better monitoring, effective and user-friendly incentive schemes, and better human resource performance management. How can one use a PES system to change behaviour?
Question 5: After reading the report back and discussion document please share your main thoughts and ideas about PES in South Africa
Question 6: Please review and recommend on the updated Conceptual Framework in the report document.

Delphi study third round questionnaire

Delphi study third round questionnaire

There were specific recommendations in the previous second round of the Delphi survey that I would like to get your final opinions on:

Question 1: Certification was identified as one of the solutions for improving the PES for the forestry industry in South Africa. Furthermore, it was also recommended by the survey that small companies can also participate in certification in cost-effective manner through adoption of a regional landscape-level approach to certification, forming co-operatives through jointly owned enterprises to address common issues and by using honest brokers to collect small supplies together into economies of scale. This recommendation is also corroborated by literature that indicated that there is a new way to bring smaller companies that cannot afford certification such as small scales growers where they can be certified under SAFA (South African Forestry Assurance schemes) that was initiated to cover the needs of small-scale timber growers. South African plantation forestry now offers two certification standards in order to cater for all medium and small scales growers (FSA, 2018). Do you agree with this recommendation that certification can be designed and implemented in such a way that it can be used by both large and small companies in improving PES in South Africa?
Question 2: It was agreed that a national policy is necessary to drive and manage a successful PES. In order to address the lack of a national policy framework for PES in South Africa, the survey recommended that such a policy should be developed and focus amongst other things on ensuring that water preservation is maximized as a critical and scarce resource. Landowners should be incentivized to manage resources to provide ES; environmental regulations are enforced and lastly on the development of a strong and clear payment transaction mechanism between the buyers and the sellers. Currently FSC have launched a new ecosystem procedure that will be used to protect the ES (FSC, 2018). The procedure aims to create incentives for the preservation of the ES such as water, carbon, biodiversity, soil, and recreational services. (FSC, 2018). Do you support this recommendation to develop a national policy program with the key elements stated above as the main focus?

Question 3: Good management is key in the development of a successful PES in South Africa. A system approach to management of the complexities of PES is vital and it needs to ensure that all the relevant key pillars are in place such as good administration and institutional capacity; a sound partnership between private and public sectors; a simple, effective, and auditable payment system; a clear incentive, rewards and penalties scheme; a well-defined set of key indicators for monitoring and evaluation of the performance of the system and enforcement of regulations. According to FSA environmental guidelines for commercial forestry plantations in SA developed in 2017, which also is being updated annually in line with environmental best management practice in SA to assist timber growers in minimising the impacts on biodiversity by establishing ecological corridors between timber compartments and managing unplanted land to improve biodiversity conservation. The guideline also helps with good management practises in minimize the negative impacts in the plantation forests (FSA, 2019). Can you comment on this system approach as a way to best manage the complexities of a PES?

Thank you for your time.